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ABSTRACT

This publication, a result of the Basic Skills Assessment Program (BSAP), is designed for use as a resource or reference guide and not as a basic skills textbook. It focuses on that part of the mathematics curriculum which is reflected in the South Carolina State Basic Skills Objectives. Information is provided not only for the grades tested by BSAP (1, 2, 3, 6, 8, and 11), but for other grades as well; however, the focus is on grades 9-12. Following an introduction, there is one section for each of the five State Mathematics Objectives: concepts, operations, measurement, geometry, and problem solving. In each, both general information which applies to all grades or particular ranges, and specific by-grade information is given. For each objective, subskills are identified, numerous instructional activities are suggested, and a general overview of the test item is provided. A skill difficulty chart is included, as are content supplements, sample test items, and directions to teachers on developing items. (MNS)

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Mathematics

Grades 9 - 12

T&T

Teaching and Testing
Our Basic Skills Objectives

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Basic Skills Assessment Program
South Carolina Department of Education

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DEPARTMENT OF EDUCATION

BASIC SKILLS ASSESSMENT PROGRAM

This guide is the fourth in the Mathematics T & T Series (yellow).

T & T, Grades 1, 2, 3

T & T, Grades 4, 5, 6

T & T, Grades 7 and 8

T & T, Grades 9-12

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TEACHING AND TESTING
OUR BASIC SKILLS OBJECTIVES
(T & T)

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Introduction

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HOW TO USE T & T

AREA: Mathematics GRADE: All

Purpose

As a result of the Basic Skills Assessment Program (BSAP), a substantial contribution to education in South Carolina will be that of instructional improvement. The purpose of T & T is to provide educators - primarily, local level administrators and teachers - with a tool for curriculum and instructional development which complements the assessment of the State Objectives in Mathematics. T & T provides a summary of the skills that should be considered instructionally and how each objective is tested.

This publication should be used as a resource or reference guide and not as a basic skills textbook. The intent of this guide is not to limit the curriculum but rather to focus on that part of the curriculum which is reflected in the State Basic Skills Objectives. Although the actual BSAP testing is limited to Grades 1, 2, 3, 6, 8, and 11, this guide also contains information on the State Mathematics Objectives for use by teachers for the grades not tested - Grades 4, 5, 7, 9, 10, and 12.

The State Kindergarten Objectives are not included in T & T. However, this in no way detracts from their instructional significance for kindergarteners and for primary grade students. The 18 Kindergarten Objectives are the primary components of a strong readiness program aimed at fundamental skills necessary to future success in Reading, Writing, and Mathematics.

Organization

Following the Introduction, there is one section for each of the five State Mathematics Objectives.

Introduction (white)
Concepts (yellow)
Operations (white)
Measurement (yellow)
Geometry (white)
Problem Solving (yellow)

Two types of information are provided within each color-coded objective section: (1) general information which applies to all grades or particular grade ranges and (2) specific by-grade information.

Information which applies to all grades (GRADE: All) or a particular grade range (GRADE: Early, Later, 1-3, 4-6, 7 & 8, or 9-12) is provided first. This information is duplicated in each book in the T & T Mathematics series to provide teachers with an understanding of the basic skills instructional continuum for Grades 1-12.

Information which applies to a particular grade level (GRADE: 8, or 9-12) is provided next. This information is not duplicated in each T & T Mathematics Booklet. The information in each objective section is organized as follows.

GRADE: ALL

TEACHING OUR SKILLS

- What Skills Ought To Be Considered
- What Are Some Ideas For Activities

TESTING OUR SKILLS

- How Skills Are Tested
- Skill Difficulty Chart
- Skill Difficulty Chart 9-12 Supplement
- Content Supplements (if applicable)

GRADE: 8

TEACHING OUR SKILLS

- What Skills Ought To Be Considered

TESTING OUR SKILLS

- How Skills Are Tested (Sample Test Items)

GRADE: 9-12

TEACHING OUR SKILLS

- What Skills Ought To Be Considered

TESTING OUR SKILLS

- How Skills Are Tested (Sample Test Items)

T & T has been organized and formatted to facilitate use by district personnel for in-service and to facilitate use by teachers. This guide can be tailored to the particular needs of individuals. For example, a district level person may wish to consolidate T & T for one or more grades, leaving out duplicate information, while teachers may simply want to add another grade level section to their T & T's.

Pagination

Each page number is made up of three components: (1) the area or objective abbreviation is first, (2) the grade symbol follows the hyphen, and (3) the page sequence number follows the decimal point. For example, CN-0.4 is read as follows: Concepts, information for all grades, page 4. The letter a is used to denote the back of a page. Therefore, CN-0.4a would be the page number on the back of page CN-0.4. Other examples using the abbreviations and symbols follow.

Example	Area/Objective
M-0.1	M = Introduction (Mathematics)
CN-8.1	CN = Concepts
OP-8.1	OP = Operations
ME-9.1	ME = Measurement
GE-9.1	GE = Geometry
PS-9.1	PS = Problem Solving

Grade Level

0 = Information for all grades or a range of grades (i.e., EARLY, LATER, 1-3, 4-6, 7 & 8, or 9-12)

8 = Information for 8th grade

9 = Information for 9th through 12th grades

For the T & T Mathematics series, the pages, regardless of the page number and grade range of the booklet, contain the same information, except for those page numbers that are asterisked (*). The contents of these asterisked pages change depending on the grade range of the T & T booklet.

Important Features of T & T

Subskills

For each objective, the subskills that were identified for testing are given. Like the objectives, these skills repeat at each grade; however, all subskills may not be tested at every grade.

A chart which gives an overview across grades is provided (for example, refer to page CN-0.2). The following symbols are used.

O	- Open circles indicate that the skill is not tested on the Basic Skills Tests, but, nevertheless, should be considered instructionally.
●	- Solid circles indicate that the skill is tested on the Basic Skills Tests and should be considered instructionally.
Blank	- No circles indicates that the skill may not be appropriate for that grade.

The same information in the chart is duplicated in the corresponding grade level section for the given objective (for example, refer to page CN-9.1).

Other Important Skills

In addition to the subskills, there are other skills that are instructionally important which are not directly tested on the Basic Skills Tests.

A chart which provides an overview of the instructional placement across grades is provided (for example, refer to page CN-0.2a).

O	- Open circles indicate that the skill is not tested on the Basic Skills Tests but, nevertheless, should be considered instructionally.
Blank	- No circle indicates that the skill may not be appropriate for that grade.

The same information in the chart is duplicated in the corresponding grade level section for the given objective (for example, refer to page CN-9.1a).

Activities

For each objective, instructional activities are suggested for helping the student learn the basic skills. Many of the early grade activities (GRADE: Early), although elementary in nature, may provide you with ideas for activities for older students. Strategies normally used at the elementary level can be adapted for use with older students if the teacher modifies them for a more sophisticated audience. Similarly, many of the later grade activities (GRADE: Later) can be adapted for use with younger students. When working with students, teachers should be careful to conduct diagnostic activities in a setting which protects the self-concepts of the students involved.

Teachers are encouraged to use other resources, as well as their own ideas, in coming up with other activities. A page is included for teachers to make note of references to other resource materials (for example, refer to page CN-0.3).

Test Item Description: Overview

For each objective, a general overview of the test item is provided (for example, refer to page CN-0.12). The overview provides the rationale behind the development of test items for all grades. Reading this information is crucial to your understanding of how the objective is tested.

Skill Difficulty Chart

There is one Skill Difficulty Chart for each objective. This chart illustrates the instructional continuum which serves as the basis for testing. These charts should provide local administrators and teachers with guidance in planning their instructional programs for basic skills.

The content of the Skill Difficulty Chart for each objective is not exhaustive. Therefore, teachers at all grade levels are encouraged to refer to the Suggested Measurement Strategy accompanying each State Objective.

A description of the chart follows (for example, refer to page CN-0.19*).

OBJ./SUB. - In the far left column, the objective (OBJ.) or Subskills (SUB.) tested are listed. In this column, information that applies to all subskills is provided first and is labeled "ALL SUB-SKILLS". This section is not in all charts. Information that is specific to particular subskills is provided next and is labeled with the subskill name (for example, Counting).

SKILL KEYS - In the next column over, the controls used in developing test items are given (for example, NATURE OF PROBLEM). These controls were used to increase the difficulty of the test items across grades.

CHART ENTRIES - In the chart entries for each grade, instructionally relevant information about the SKILL KEYS is provided. For Grades 9-12, this information is given in the Skill Difficulty Chart Grade 9-12 Supplement (for example, refer to page CN-0.20*).

For those grades that do not take the Basic Skills Tests, the chart entries are left blank for you to complete by consulting the Suggested Measurement Strategy for the State Objective.

Content Supplements

These supplements, where pertinent, follow the Skill Difficulty Charts (for example, refer to pages ME-0.19* to ME-0.23*). In these sections, the content eligible for testing a specific subskill at each grade is detailed. For those supplements designated as cumulative, the content at earlier grades applies to subsequent grades and should be considered instructionally.

Sample Test Items and Directions

Samples of the types of test items on the Basic Skills Tests are given by grade for each objective (for example, refer to pages CN-9.2 to CN-9.7). These sample test items, with their directions, can serve as a guide in classroom assessment of basic skills instruction. The "Directions" indicate how the test item is administered. The following terms are used with the "Directions".

1. "Student reads." - The information is read by the student from the test booklet.

2. "Teacher/Student read." - The information appears in both the Teacher's Administration Manual and test booklet. The teacher reads the information while the student follows and reads silently.

Write Your Own Items

For each sample test item, there is space for you to write your own item. Pages can be added if you write more items. Share them with other teachers. When you write your items, make sure your items at least meet the criteria in the Skill Difficulty Charts. In "How to Write Your Own Items" at the end of this section, illustrations and specific directions on how to write your own items are given.

WHAT IS THE READING LEVEL OF THE TESTS

AREA: Mathematics GRADE: All

The criteria in this chart apply to the Basic Skills Tests for all State Mathematics Objectives in which selections and/or directions are read by the student.

MATHEMATICS PROBLEMS

READING CONTROLS	GRADE 1	GRADE 2	GRADE 3	GRADE 6	GRADE 8	GRADE 11
PROBLEM LENGTH	24 words maximum	24 words maximum	30 words maximum	40 words maximum	50 words maximum	75 words maximum
NUMBER OF SENTENCES	3 sentences	4 sentences maximum	4 sentences maximum	No limits	No limits	No limits
SENTENCE LENGTH	8 words maximum	8 words maximum	10 words maximum	14 words maximum	16 words maximum	20 words maximum
SENTENCE STRUCTURE	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
VOCABULARY DIFFICULTY[a]	S. C. Word List, Grade 1 Mathematics Word List, Grade 1	S. C. Word List, Grade 1 Mathematics Word List, Grade 2 or below	S. C. Word List, Grade 2 or below Mathematics Word List, Grade 3 or below	S. C. Word List, Grade 4 or below Mathematics Word List, Grade 6 or below	S. C. Word List, Grade 6 or below Mathematics Word List, Grade 8 or below	S. C. Word List, Grade 9 or below Mathematics Word List, Grade 11 or below

[a] Refer to the publication the South Carolina Word List and to the Mathematics Word List in T & T.

HOW TO USE THE MATHEMATICS WORD LIST

AREA: Mathematics GRADE: All

Purpose of Word List

The Mathematics Word List is a supplement to the South Carolina Word List. The words included on the Mathematics Word List which follows are vocabulary words which may appear in the mathematics test items at each grade.

The list is not intended to be comprehensive. Other important mathematics vocabulary words (e.g., add, factor, quotient, etc.) are not on this list. Teachers should add other important words to the list.

The list is cumulative; therefore, students at each grade should know words for all previous grades.

MATHEMATICS WORD LIST

AREA: Mathematics GRADE: 1-3

This list is cumulative; therefore, students at each grade should know words for all previous grades.

Grade 1

altogether
answer
below
between
bubble
circle
clock
closed
coin
count
curve
darken
days of the week
digit
fall
heavy
hot
hour
largest
left
mark
month
names of months in a year
nickel
number
objects
open
penny
place
problem
quarter
rectangle
same
seasons of the year
shape
smallest
spring
square
summer
tall
temperature
tens
triangle
use
warm
weigh
week
winter
word names of numbers 1-10
worth

Grade 2

Celsius
centimeter(s)
cold
cup(s)
dollar
Farenheit
fifth
figure
first
fourth
half-dollar
inch(es)
kilogram(s)
least
missing
most
o'clock
pair
pound(s)
sentence
second(s)
shaded
shown
size
tells
third
thermometer
true
unit
warm
wide
word names of numbers 10-399

Grade 3

angle
costs
dotted
exactly
folded
gallon
inside
line
meter
millimeter(s)
outside
pint(s)
point
quart(s)
ray
right angle
segment
word names of numbers 400-999
yard

MATHEMATICS WORD LIST

AREA: Mathematics

GRADE: 4-6

This list is cumulative; therefore, students at each grade should know words for all previous grades.

Grade 4

(Grade 3 words and other appropriate words)

Grade 5

(Grades 1-4 words and other appropriate words)

Grade 6

- area
- average
- center
- circumference
- cone
- congruent
- cube
- cylinder
- diagonal
- diameter
- equilateral
- equal
- estimate
- gram(s)
- hundredth(s)
- intersecting
- intersection
- isosceles
- kilogram(s)
- kilometer(s)
- liter(s)
- metric ton
- midpoint
- milliliter(s)
- parallel
- parallelogram
- perimeter
- perpendicular
- polygon
- radius
- ray
- rhombus
- scalene
- sphere
- tenths
- thousand(s)
- vertex
- volume

MATHEMATICS WORD LIST

AREA: Mathematics

GRADE: 7 & 8
9 - 12**

This list is cumulative; therefore, students at each grade should know words for all previous grades.

Grade 7

(Grades 1-6 words
and other
appropriate words)

Grade 8

acute angle
approximate
average
bisector
construction(s)
coordinate
grid
hexagon
obtuse angle
pentagon
quadrilateral
rectangular
prism
scalene
similar
solid
straight
trapezoid

Grade 9-12*

All vocabulary words for Grades 1-8 are eligible for Grades 9-12.

Additionally, Financial Terminology on back of this page is eligible for Grades 9-12.

**Tested at Grade 11

MATHEMATICS WORD LIST
FINANCIAL TERMINOLOGY

AREA: Mathematics GRADE: 9-12**

Words which occur frequently in personal and consumer financial situations are encountered often by young adults. Students will need to be familiar with financial terminology for the BSAP tests.

Personal Finances

- account
- annual
- average
- balance
- budget
- check
- checking account
- checking account register
- checking account statement
- compensation
- deduct
- deduction
- deposit
- deposit slip
- dividend
- exclusion
- expenses
- income
  - gross income
  - net income
- income tax
- income tax return
- interest
  - rate of interest
  - simple interest
- overtime
- pay
  - gross pay
  - net pay
  - take home pay
- paycheck
- per annum
- percentage
- salary
  - net salary
- term
- time
- time and a half
- wage
- withdrawal

Consumer Finances

- balance due
- bill
- commission
- consumer
- credit
- credit card
- credit card statement
- currency
- discount
- down payment
- finance
- finance charge
- financial statement
- installment
- installment plan
- installment purchase
- layaway
- loan
- loan agreement
- loan payment
- merchandise
- price
- price-per-unit cost
- principal
- purchase price
- receipt
- refund
- sales tax
- subscription
- tip
- unpaid balance
- utility

**Tested at Grade 11

HOW TO WRITE YOUR OWN ITEMS

AREA: Mathematics GRADE: All

Procedure

An emphasis has been placed on multiple-choice items in T & T because these types of items are the ones used in the Basic Skills Tests. Well-constructed fill-in-the-blank items are as necessary to the mathematics teacher as are multiple-choice items. Perhaps more important than the type of item, whether multiple-choice, fill-in-the-blank, or true-false is the quality of the item. Multiple-choice or other types of items can reflect trivial or off-target responses. Moreover, any type of item can be constructed to reflect basic skills objectives at the appropriate level of difficulty.

Although the sample items are multiple-choice, the first step toward constructing a multiple-choice item may involve the use of fill-in-the-blank items.

The following procedure may be used for writing your own test items.

1. Write fill-in-the blank questions for an objective.
2. Try out the questions on the students in your class to get information for incorrect answer choices.
3. Score the items.
4. Correct any flaws in your test questions.
5. Use the most appropriate incorrect responses as answer choices.
6. Use any information on correct responses in your instruction.
7. Put the items in multiple-choice format and administer them again as a posttest or during the next year.

To practice the item writing process, administer one of the sample items to the appropriate students as fill-in-the-blank items. Then, compare the incorrect student responses to the incorrect responses given with the sample item. After you review your student responses and study how to use T & T, try writing your own items for the grade that you teach.

Annotated Sample Items

On the following pages, sample items for Problem Solving are presented for Grades 1, 2, 3, 6, 8, and 11. The sample item is presented in the left column and information on how to use T & T to write the test items is provided in the right column.

The sample items have been purposefully constructed to illustrate how the test items build on one another as grade levels increase. These items and their annotations should provide you with models on writing your own items for other objectives and subskills. The readability chart on Page M-0.5, the Skill Difficulty Chart SKILL KEYS, and the sample test items for each objective contain the information necessary for writing your own test items.

As an exercise, examine the Skill Difficulty Chart for Problem Solving and determine the key difficulty elements that change from grade to grade and concurrently examine the annotated sample items. Try this for all objectives and subskills.

HOW TO WRITE YOUR OWN ITEMS

OBJECTIVE: Problem Solving GRADE: 1

Sample Item, Grade 1	Writing Items with T & T
John has 4¢. He gets 1¢ more. How much money does John have now? (over)	Word Problem Note: Refer to the chart on page M-0.5, the Skill Difficulty Chart SKILL KEYS on page PS-0.15*, and the sample items for this objective. PROBLEM TYPE: Arithmetic READABILITY: Total words 24 or less, 3 sentences, up to 8 words per sentence, Grade 1 vocabulary (see S. C. Word List) METHOD OF OBTAINING DATA: Verbal text only UNNECESSARY DATA: Not allowed TYPES OF NUMBERS: Whole numbers NUMBER OF OPERATIONS: Only one allowed TYPES OF OPERATIONS REQUIRED: Addition or subtraction (Addition needed for this item) OPERATION DIFFICULTY: No regrouping allowed TYPE OF PROBLEM SOLUTION: Exact (over)

OBJECTIVE: Problem Solving GRADE: 1

Sample Item, Grade 1	Writing Items with T & T
3¢ ○ 4¢ ○ 5¢ ●	Answer Choices Incorrect responses should all represent typical errors students might make, for example, errors in data selection, selection of operations, or computation. 3¢ - Wrong Operation: Subtracted 4¢ - 1¢ = 3¢ 4¢ - Data Selection Error: Selected one piece of data 4¢ as answer 5¢ - Correct: 4¢ + 1¢ = 5¢

HOW TO WRITE YOUR OWN ITEMS

OBJECTIVE: Problem Solving GRADE: 2

Sample Item, Grade 2	Writing Items with T & T
John had 14¢. He gets 3¢ from his mother. How much money does John have now? (over)	Word Problem Note: Refer to the chart on page M-0.5, the Skill Difficulty Chart SKILL KEYS on page PS-0.15*, and the sample items for this objective. PROBLEM TYPE: Arithmetic READABILITY: Total words 24 or less, up to 4 sentences, up to 8 words per sentence, Grade 1 vocabulary (see S. C. Word List) METHOD OF OBTAINING DATA: Verbal text only UNNECESSARY DATA: Not allowed TYPES OF NUMBERS: Whole numbers NUMBER OF OPERATIONS: Only one allowed TYPES OF OPERATIONS REQUIRED: Addition or subtraction (Addition needed for this item) OPERATION DIFFICULTY: No regrouping TYPE OF PROBLEM SOLUTION: Exact (over)

OBJECTIVE: Problem Solving GRADE: 2

Sample Item, Grade 2	Writing Items with T & T
11¢ ○ 14¢ ○ 17¢ ●	Answer Choices Incorrect responses should all represent typical errors students might make, for example, errors in data selection, selection of operations, computation, or sequence of operations. 11¢ - Wrong Operation: Subtracted 14¢ - 3¢ = 11¢ 14¢ - Data Selection Error: Used one piece of data 14¢ as the answer 17¢ - Correct: 14¢ + 3¢ = 17¢

HOW TO WRITE YOUR OWN ITEMS

OBJECTIVE: Problem Solving GRADE: 3

Sample Item, Grade 3	Writing Items with T & T
John has 14¢ in his bank. He finds another 5¢ in a chair. John buys a 15¢ candy bar. How much money does John have now? (over)	Word Problem Note: Refer to the chart on page M-0.5, the Skill Difficulty Chart SKILL KEYS on page PS-0.15*, and the sample items for this objective. PROBLEM TYPE: Arithmetic READABILITY: Total words 30 or less, no more than 4 sentences, up to 10 words per sentence, Grade 2 vocabulary or below (see S. C. Word List) METHOD OF OBTAINING DATA: Verbal text UNNECESSARY DATA: Allowed, but not necessary (None in this item) TYPES OF NUMBERS: Whole numbers NUMBER OF OPERATIONS: 1 or 2 (2 for this item) TYPES OF OPERATIONS REQUIRED: Addition, subtraction, or multiplication (Addition and subtraction needed for this item) OPERATION DIFFICULTY: Regrouping, direct conversions TYPE OF PROBLEM SOLUTION: Exact (over)

OBJECTIVE: Problem Solving GRADE: 3

Sample Item, Grade 3	Writing Items with T & T
4¢ 5¢ 19¢ ● ○ ○	Answer Choices Incorrect responses should all represent typical errors students might make, for example, errors in data selection, selection of operations, computation, or sequence of operations. 4¢ - Correct: 14¢ + 5¢ = 19¢ 19¢ - 15¢ = 4¢ 5¢ - Data Selection Problem: Used only one piece of data 5¢ as answer 19¢ - Data Selection Problem: Performed only the addition operation, 14¢ + 5¢ = 19¢

HOW TO WRITE YOUR OWN ITEMS

OBJECTIVE: Problem Solving GRADE: 4-6**

Sample Item, Grade 6	Writing Items with T & T
John likes to play racket ball. A racket ball court rents for $1.50 per hour. John has $1.50 and his friend has $6.00. If each pays the same amount, what is the longest time they can play together?	Word Problem Note: Refer to the chart on page M-0.5, the Skill Difficulty Chart SKILL KEYS on page PS-0.15*, and the sample items for this objective. PROBLEM TYPE: Arithmetic, measurement, and/or geometry (Arithmetic for this item) READABILITY: Total words 40 or less, up to 14 words per sentence, Grade 4 vocabulary or below (see S. C. Word List) METHOD OF OBTAINING DATA: Verbal text (may be accompanied by pictorial display) UNNECESSARY DATA: Allowed (None present in this item) TYPES OF NUMBERS: Whole numbers, fractions, mixed numbers, decimals (Decimals used in this item) NUMBER OF OPERATIONS: up to 3 (2 may be required for this item) TYPES OF OPERATIONS REQUIRED: Addition, subtraction, multiplication, and/or division (Addition and division may be required for this item)
(over)	(over)

**Tested at Grade 6

OBJECTIVE: Problem Solving GRADE: 4-6**

Sample Item, Grade 6	Writing Items with T & T
	Word Problem (continued) OPERATION DIFFICULTY: Regrouping, reduction of fractions, measurement conversions (Regrouping may be required for this item) TYPE OF PROBLEM SOLUTION: Exact or estimated (Exact for this item) Answer Choices Incorrect responses should all represent typical errors students might make, for example, data selection errors, operational errors, arithmetic errors, errors in unit selection, or estimation errors
(A) 1 hr.	1 hr. - Data Selection Error: Considered John's money only, per hour cost, \$1.50 ÷ \$1.50 = 1 hr.
(B) 2 hrs.*	2 hrs. - Correct: John has only \$1.50 and his friend has at least \$1.50, therefore, can play for 2 hours; \$1.50 + \$1.50 = \$3.00, \$3.00 ÷ \$1.50 = 2 hrs.
(C) 4 hrs.	4 hrs. - Data Selection Error: Considered friend's money only, \$6.00 ÷ \$1.50 = 4 hrs.
(D) 5 hrs.	5 hrs. - Data Selection Error: Considered total of John and friend's money, forgot about same amount qualifier, \$7.50 ÷ \$1.50 = 5 hrs.

**Tested at Grade 6

HOW TO WRITE YOUR OWN ITEMS

OBJECTIVE: Problem Solving GRADE: 7 & 8**

Sample Item, Grade 8

Tennis Sale

Rackets (frame only)	
Borg	$75.00
Davis	$26.95
Wilson	$22.00
Yamaha	$55.00
Balls (can of 3)	$ 2.00 per can
Shorts	$10.50 per pair
Shirts	$12.25 each
Strings:	
Blue Star	$15.00
Gut	$26.00

John has $100.00 to spend on new tennis equipment. With his money, he buys 1 can of balls, 1 pair of shorts, and 1 shirt. John also buys a new racket with Blue Star strings. He buys the least expensive racket. How much money does he have left after he buys all of this equipment?

(over)

Writing Items with T & T

Word Problem

Note: Refer to the chart on page M-0.5, the Skill Difficulty Chart SKILL KEYS on page PS-0.15*, and the sample items for this objective.

PROBLEM TYPE: Arithmetic, measurement, and/or geometry

READABILITY: Total words 50 or less, up to 16 words per sentence, Grade 6 vocabulary or below (see S. C. Word List)

METHOD OF OBTAINING DATA: Verbal text, may require interpretation of graphic information

UNNECESSARY DATA: Allowed (Some present in this item)

TYPES OF NUMBERS: Whole numbers, fractions, mixed numbers, decimals, percentages (Decimals and whole numbers used in this item)

NUMBER OF OPERATIONS: Up to 3 (2 or 3 may be needed for this item)

TYPES OF OPERATIONS REQUIRED: Addition, subtraction, multiplication, and/or division (Addition, subtraction, and multiplication may be required for this item)

(over)

**Tested at Grade 8

OBJECTIVE: Problem Solving GRADE: 7 & 8**

Sample Item, Grade 8	Writing Items with T & T
	Word Problem (continued) OPERATION DIFFICULTY: Regrouping, reduction of fractions, measurement conversions (Regrouping may be required for this item) TYPE OF SOLUTION: Exact or estimated (Exact for this item) Answer Choices Incorrect responses should all represent typical errors students might make, for example, procedural errors, data selection errors, operational errors, arithmetic errors, errors in unit selection, or estimation errors.
(A) $38.25*	$38.25 - Correct: ($2.00 + $10.50 + $12.25) = $24.75; ($24.75 + $15.00 + $22.00) = $61.75; ($100.00 - $61.75) = $38.25
(B) $53.25	$53.25 - Data Selection Error: ($2.00 + $10.50 + $12.25) = $24.75; ($24.75 + $22.00) = $46.75 (Omitted Blue Star strings); ($100.00 - $46.75) = $53.25
(C) $60.25	$60.25 - Data Selection Error: ($2.00 + $10.50 + $12.25) = $24.75; ($24.75 + $15.00) = $39.75 (Omitted Wilson racket); ($100.00 - $39.75) = $60.25
(D) $61.75	$61.75 - Procedural Error: ($2.00 + $10.50 + $12.25 + $15.00 + $22.00) = $61.75 (Total cost of equipment, left out subtraction step)

**Tested at Grade 8

HOW TO WRITE YOUR OWN ITEMS

OBJECTIVE: Problem Solving GRADE: 9-12**

Sample Item, Grade 11	Writing Items with T & T
You are planning to construct a tennis court. Constructing the court requires 31.5 cubic yards of crushed rock and 26.7 cubic yards of asphalt. The truck from the rock company can carry 5.2 cubic yards per load. The truck from the asphalt company can carry 3.7 cubic yards per load. How many truckloads are needed to deliver all of these materials? (over)	Word Problem Note: Refer to the chart on page M-0.5, the Skill Difficulty Chart SKILL KEYS on page PS-0.15,* and the sample items for this objective. PROBLEM TYPE: Arithmetic, measurement, and/or geometry READABILITY: Total words 75 or less, up to 20 words per sentence, Grade 9 vocabulary or below (see S. C. Word List) METHOD OF OBTAINING DATA: Verbal text, may require interpretation of graphic information UNNECESSARY DATA: Allowed (None present in this item) TYPES OF NUMBERS: Whole numbers, fractions, mixed numbers, decimals, percentages (Decimals used in this item) NUMBER OF OPERATIONS: Up to 3 (2 or 3 may be needed for this item) TYPES OF OPERATIONS REQUIRED: Addition, subtraction, multiplication, and/or division (Addition and division may be required for this item) (over)

** Tested at Grade 11

OBJECTIVE: Problem Solving GRADE: 9-12**

Sample Item, Grade 11	Writing Items with T & T
	Word Problem (continued) OPERATION DIFFICULTY: Regrouping, reduction of fractions, measurement conversions (Not required for this item) TYPE OF SOLUTION: Exact, estimated, or determining missing data (Exact for this item)

** Tested at Grade 11

OBJECTIVE: Problem Solving GRADE: 9-12**

Sample Item, Grade 11	Writing Items with T & T
	Answer Choices Incorrect responses should all represent typical errors students might make, for example, procedural errors, data selection errors, operational errors, arithmetic errors, errors in unit selection, or estimation errors.
(A) 7.0	7.0 - Procedural Error: (31.5 + 26.7) ÷ (5.2 + 3.7) = 6.54, 6.54 rounded up is 7.0
(B) 8.0	8.0 - Data Selection Error: Only considered asphalt, (26.7 ÷ 3.7) = 7.22, 7.22 rounded up is 8.0
(C) 14.0	14.0 - Procedural Error: (31.5 ÷ 5.2) = 6.06, (26.7 ÷ 3.7) = 7.22, (6.06 + 7.22) = 13.28, 13.28 rounded up is 14.0
(D) 15.0*	15.0 - Correct: (31.5 ÷ 5.2) = 6.06, 6.06 rounded up is 7.0, (26.7 ÷ 3.7) = 7.22, 7.22 rounded up is 8.0, (7.0 + 8.0) = 15.0

** Tested at Grade 11

Concepts

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TEACHING OUR SKILLS

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NOTE: * - All pages contain the same information in all booklets in the T & T Mathematics series, except for asterisked (*) pages.

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Concepts GRADE: All

Objective

The student can apply numerical concepts.

Explanation

The Concepts objective promotes numerical understanding and skills that are prerequisite for mastery of other mathematics objectives. The objective includes a broad body of content from counting and determining place value to identifying numerical equivalencies and establishing numerical relationships. Tables and graphs complete the content range. The ability to interpret pictorial representations of numerical data also requires conceptual skills.

Subskills: Overview

The subskills identified for testing this objective are listed in the chart. The symbol O is used to indicate that the subskill is not tested but needs to be considered instructionally. The symbol ● indicates that the subskill is tested.

SUBSKILLS	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Counting The student can count.	●	●	●	O								
2. Identifying Equivalencies The student can identify equivalent ways of expressing the same numerical quantity.	●	●	●	O	O	●	O	●	O	O	●	O
3. Establishing Relationships The student can establish relationships between numerical quantities.	●	●	●	O	O	●	O	●	O	O	●	O
4. Determining Place Value The student can determine the place value of numerical quantities.	●	●	●	O	O	●	O	●	O	O	●	O
5. Interpreting Tables and Graphs The student can extract and interpret information from tables and graphs.	O	●	●	O	O	●	O	●	O	O	●	O
6. Recognizing Square Roots The student can recognize common square roots.									O	O	●	O
7. Using Formulas The student can apply formulas.									O	O	●	O

OBJECTIVE: Concepts

GRADE: All

Other Important Skills: Overview

Instructionally, there are some other skills that must be considered in addition to those identified for testing under this objective. The symbol O is used to indicate that the skill is not tested but needs to be considered instructionally.

SKILLS	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Comprehension of Numerical Representations The student can interpret the numerical representations for whole numbers, fractions, decimals, and percents. For example, given the numerical representation "$\frac{2}{3}$", the student associates that symbol with the concept "two-thirds."	O	O	O	O	O	O	O	O	O	O	O	O
2. Comprehension of Mathematical Terminology The student understands the following types of mathematical vocabulary: (1) the word forms for whole numbers, fractions, and decimals; (2) names referring to place value (for example, "hundredths place"); (3) relationship words (for example, "most," "least"); (4) sequencing words (for example, "before," "next"); and (5) phrases requiring the determination of a quantity (for example, "how much," "how many," "what part").	O	O	O	O	O	O	O	O	O	O	O	O
3. Comprehension of Mathematical Symbols The student understands the following types of symbols: (1) operational signs (for example, +, -, x, and ÷); (2) relations symbols (for example, =, <, and >); and (3) symbols used in conjunction with numbers (for example, decimal point, percentage sign, and exponent).	O	O	O	O	O	O	O	O	O	O	O	O
4. Comprehension of Numerical Sequence The student understands that numbers can be: (1) arranged in ascending or descending order; (2) grouped by multiples; and (3) counted forwards or backwards.	O	O	O	O	O	O	O	O	O	O	O	O
5. Comprehension of Graphic Representations The student understands that numerical quantities and data relationships can be represented either visually, (that is, in picture, circle, and bar graphs) or through a coordinate system of rows and columns (for example, is tables).	O	O	O	O	O	O	O	O	O	O	O	O
6. Comprehension of Unit Price (Grades 9-12 Only) Given the volume of a package and package price, the student can determine unit price.	O	O	O	O	O	O	O	O	O	O	O	O
7. Interpolation (Grades 9-12 Only) The student understands the concept of interpolation as it applies to graphs.	O	O	O	O	O	O	O	O	O	O	O	O

WHAT ARE SOME IDEAS FOR ACTIVITIES

OBJECTIVE: Concepts GRADE: All

Activities

On the following pages are some ideas for developing your own activities. These activities are intended only as examples to stimulate your thinking. The activities are not intended to be prescriptive. You can use these activities to help in building student skills.

For each activity, the purpose, the materials you need, and the directions are given. The activities are not designated by grade level since many of them can be adapted for use in earlier or later grades. You may wish to add worksheets and/or activities of your own.

Resources

Below is space for you to note resource materials appropriate for the grade(s) you teach.

Subskill	Resource Material
1. Counting	
2. Identifying Equivalencies	
3. Establishing Relationships	
4. Determining Place Value	
5. Interpreting Tables and Graphs	
6. Recognizing Square Roots	
7. Using Formulas	

CN-0.4

ACTIVITY: Counting Time **GRADE:** Early

Purpose: To provide practice in the skills associated with counting and establishing number sequences

Materials: Blank Sheets of Paper and Chalkboard

Directions:

1. Distribute blank sheets of paper. Write a numeral on the chalkboard. Ask students to copy the numeral on their papers and then draw a set of objects equal in number. Let students exchange their papers and check each other's work.

2. Have students complete exercises such as the following, either at the chalkboard or on duplicated practice sheets.

ONE LESS	SET	ONE MORE
	□ □ □	
	△ △	
	○ ○ ○ ○ ○	

After students have completed such a chart, have them print the numeral that corresponds to each group of objects next to that group.

3. Have students arrange objects according to your oral directions. For example, "Put an eraser first, a pencil second, a crayon third, and a ruler fourth." After the objects are placed in order, ask students to hold up a particular object; for example, "hold up the third thing." Students can take turns giving the directionsto the class.

4. Assign each child a counting number. When it is time to have the class line up (for example, for recess or dismissal), or to divide into groups (for example, for a game), have students arrange themselves according to your directions. Base these directions on the assigned numbers. Students might line up in order from the smallest to the largest number or vice versa. Students might split into two groups according to even and odd numbers. Or students might form several groups by "counting off" using different multiples.

5. Prepare slips of paper based on a sequence of numbers. Each slip should have a different number on it. Write the word "least" at one end of the chalkboard and the word "greatest" at the other end. Students are to pick a slip of paper and position themselves in front of the board, according to the number drawn. The first student stands where he or she thinks is appropriate. Subsequent students arrange themselves around this student to form a line with their numbers in the sequential order shown on the board. At first this activity might be conducted with a simple sequence of numbers (counting by ones, for example). As students become more proficient at ordering themselves, more complex sequences might be employed.

ACTIVITY: Block Busters **GRADE:** Early

Purpose: To promote learning of numerical equalities and inequalities and to provide understanding of mathematical symbols and terminology

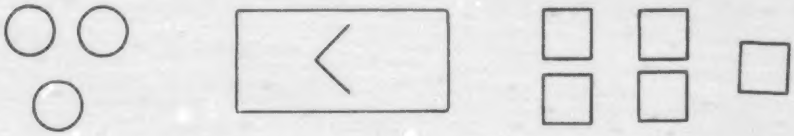
Materials: A Set of 10-30 Similar Objects, Index Cards, Chalkboard

Make or obtain a set of 10-30 similar objects (for example, blocks, cardboard counters, cut-out drawings).

Directions:

1. Distribute a set of the 10-30 similar objects to each student.
2. Have each student prepare index cards with a single mathematical symbol printed on each one. These symbols might include +, -, =, <, and > .
3. Have students arrange the objects on their desks so that the index card symbol is between two groups of objectives.

Example:



4. Have students write the mathematical expression that corresponds to each arrangement on the chalkboard and then compare the expressions that resulted.

ACTIVITY: How Many Ways? **GRADE:** Early

Purpose: To promote students' skill with identifying numerical equivalencies

Materials: None

Directions:

1. Call out a single number (for example, 20). Students are to write down as many equivalents for that number as they can think of (for example 10 + 10, 30 - 10, 20 + 0).
2. Then, have students, take turns suggesting their equivalents, seeing how long of a list the class can develop.
3. As a variation, call out a number (for example, 225) and have students write down as many different ways of writing that number as they can think of (for example, 200 + 20 + 5; 225 ones; 22 tens + 5 ones; two hundreds + twenty-five ones; two hundreds + two tens + five ones).

ACTIVITY: Parts of the Whole **GRADE:** Early

Purpose: To help students develop skill in conceptualizing fractions

Materials: Sets of Objects, Chalkboard, and Drawing Paper

Directions:

1. Give students sets of objects (for example, a set of 12 beans). Then ask them to divide the set into equal-sized smaller sets (for example, two sets of six objects, three sets of four objects). Provide or have students supply the appropriate fractional name to label each division of objects (for example, halves, thirds, fourths).
2. Direct students to form various configurations with their objects (for example, placing one-third of the objects under a piece of paper and leaving two-thirds of the objects uncovered).
3. Write a group of proper fractions on the chalkboard. The denominators of these fractions should range between 2 and 12. Ask students to prepare drawings to illustrate each fraction.
4. Display students' work to demonstrate the various ways each fraction can be represented.

ACTIVITY: People-Graphs GRADE: Early

Purpose: To familiarize students in the formation as well as interpretation of graphs

Materials: Chalk

Make a chalkline at one side of an open area. The chalkline should be evenly divided and labeled with heading based on an characteristic common to all students. This attribute might be month of birth, hair color, number of sisters and brothers, etc. The headings may be chalked on the floor or printed on signs.

Directions:

1. Ask students to line up behind the appropriate labels, thus forming a living graph.
2. Call on individual students to answer questions about information presented in the living graph (for example, "What color eyes do the greatest number of children have?").
3. Students can suggest their own ideas for characteristics for a graph. After a living graph has been formed, students may transfer the information gathered to a bar or picture graph which they prepare themselves.

ACTIVITY: Show Me GRADE: Early

Purpose: To promote learning of many different numerical concepts

Materials: Chalkboard

Directions:

1. Write a single number on the chalkboard. Use either its numerical or word form.
2. Direct students to find a concrete way to represent what has been written. They might, for example, collect five objects to exemplify the word "five," or fold a paper in thirds and then cut off one piece to demonstrate the number $\frac{2}{3}$.
3. Compare and discuss the various representations that students present.

ACTIVITY: Another Way GRADE: Later

Purpose: To provide practice using mathematical symbols and terminology

Materials: Chalkboard and Verbal Sentence

Write a verbal sentence on the Board.

Example: Nine hundred ninety-nine and nine hundredths is less than ten times one hundred.

Directions:

1. Ask students to substitute as many mathematical symbols as they can for the words used.

   Example: $999.09 < 10 \times 100$

2. Practice the activity in reverse by writing a mathematical sentence on the board and asking students to translate it into words.

   Example: Nine hundred ninety nine and nine hundredths is less than the product of ten and one hundred.

3. Have students take turns making up verbal and mathematical sentences to present to the rest of the class for translation. A class collection of "super sentences" might be developed, based on sentences that have proved particularly challenging.

ACTIVITY: What's My Number GRADE: Later

Purpose: To promote logical thinking as well as knowledge of numerical equivalents and relationships

Materials: None

Directions:

1. Select a student to play the role of a number. Introduce this student to the rest of the class in a manner that gives a clue as to the student's number identity. For example, "Mr. X is a whole number between 2 and 15" or "Ms. Y is an improper fraction between 2 and 7".

2. The other students take turn asking questions of the mystery number. Only questions answerable "yes" or "no" are allowed.

   Example: "Are you an even number?"

3. Any student who wishes to do so may try to guess the number's identity. If the student is correct, he or she becomes the next mystery number. Incorrect guessers are out of the game until the next round of play.

4. The game can be made more difficult by eliminating any clues as to the number's identity when introducing the mystery number and by broadening the range of numbers eligible for play. Students will have to structure their questions to find out the mystery number's identity and the range in which it falls.

   Example: "Are you a whole number?" (Answer: Yes)
   "Are you between 1 and 50?" (Answer: No)
   "Are you between 50 and 100?" (Answer: Yes)

ACTIVITY: Number Call Out GRADE: Later

Purpose: To increase students' familiarity with number equivalents

Materials: Blank Bingo Cards, Number Lists, and Card Markers

Prepare sets of blank bingo cards (i.e., cards divided into 25 squares). Also, prepare lists of 40-50 decimal numbers, fractions, mixed numbers, percentages, or ratios.

Directions:

1. Decide which list of numbers to use for a series of games. Distribute the list to students along with one or more blank game cards for each player.

2. Allow students time to fill in their bingo cards. Students must write a different number in each square. All numbers must be equivalents for numbers contained on the list which was passed out previously. For example, if the list contained the decimal fraction .25, students could enter 25% or $\frac{1}{4}$ or 1:4 on their card.

3. Play begins when numbers are selected at random from the number list and then called out to the class. Students use markers to cover each number on their card that is an equivalent for a number called.

4. Potential winners must have their cards checked to verify that the equivalencies identified were the correct ones.

ACTIVITY: Questions and Answers GRADE: Later

Purpose: To provide a lesson in survey methods as well as the preparation of tables and graphs

Materials: Drawing and/or Graph Paper

Directions:

1. Have the class decide on an interesting survey question to ask people. A question with several possible answers should be selected (for example, "What is your favorite food?").
2. Each student is to ask the question of several people out of class and record the answers received.
3. After tabulating the data collected, the class should discuss the ways in which that information can be presented.
4. Working alone or in groups, students prepare all the various types of tables and/or graphs that can be made based on the survey results. (For instance, there might be a circle graph, a bar graph, and a table.)
5. When all the representations are completed, discuss the advantages and disadvantages of each form, noting whether any one is a more effective means of presentation than the others.

ACTIVITY: Check It Out **GRADE:** Later (9-12)

Purpose: To familiarize students with writing out numerical equivalencies

Materials: Sample Blank Checks and Expense Cards

Obtain sample blank checks that students can use for "paying" expenses. These checks may be duplicated from an actual check book or drawn to appear real. Prepare expense cards by writing a single numerical monetary amount or a word and a fractional monetary amount on a card with a statement about the nature of the bill.

Examples:

Wade's Grocery Store
thirty-eight and $\frac{18}{100}$ dollars

or

Milton's Music Shop
$17.32

Directions:

1. Let students draw cards and have students write checks to match the expense cards they have drawn. The students should make sure that the numerical values and the word values are equivalent forms of the monetary amounts.

2. Have students exchange their checks and expense cards and review each other's work for accuracy.

ACTIVITY: Supermarket Survey GRADE: Later (9-12)

Purpose: To provide useful consumer information to students while also teaching unit pricing and to provide practice in determining relationships between prices of various products

Materials: Newspaper

Directions:

1. Divide the class into teams and assign each team a different local market. The number of teams will depend on the number of markets. If necessary, all students can use the same market.

2. Select a variety of products that would be familiar to students and that appear in the daily newspaper ads. Ask the teams to obtain size and price information on each product from the newspaper. If the product is available in more than one size, use the size and price of the largest and smallest sizes in the store.

3. In class, ask the students to calculate unit prices for the products and enter them on a table of unit prices. The finished table can be duplicated and distributed to the class as well as to other classes if desired.

CN-0.14*

ACTIVITY: Round-Up GRADE: Later (9-12)

Purpose: To provide practice in rounding numbers to a specified place value

Materials: None

Directions:

1. Divide the class into two teams.

2. Select a particular place value and inform students that all numbers will be rounded to that place, e.g., hundreds. Specify rounding rules.

3. Call out a number to a member of each team.

4. The first student to correctly say aloud whether the number should be rounded "up" or "down" in the specified place is then given the chance to round the number to that place value.

   Example: The selected place value is hundreds. The number is 9437. The student who calls out "down" is given a chance to round the number to the hundreds place. The correct answer is 9400.

5. If the student is correct, a point is awarded to that student's team. If the student is incorrect, the opponent is given the chance to provide the correct answer and score one point. If a student from neither team can correctly round the number after two more tries to each team, the correct answer is given, and another number is called out.

6. As a follow-up activity, compile lists of numbers at least 4 to 5 digits long. Ask the students to break down the place value of each number on the list in a chart as follows.

   Example: 354.293

Rounded to:	354.293 is between	354.293 is closest to
Hundreds	300 and 400	400
Tens	350 and 360	350
Ones	354 and 355	354
Tenths	___ and ___	___
Hundredths	___ and ___	___
Thousandths	___ and ___	___

ACTIVITY: Graphic Arts GRADE: Later (9-12)

Purpose: To help students comprehend the underlying principles used in the construction of tables and graphs

Materials: Several Examples of Graphs and Tables

Provide the class with several examples of each of the common types of graphs (line, bar, picture, and circle) and of tables.

Directions:

1. Discuss with the students the kinds of information presented in the graphs and tables, and help the class determine why a given graphic or tabular format is the most appropriate for each type of information. Develop criteria for the type of information best presented in a table and in each type of graph.

2. Describe various types of relationships and ask students to use the criteria developed in Step 1 to decide on the best format for presenting each relationship. Solicit suggestions of relationships from students and subject students' suggestions to similar analysis.

3. Give the students some actual data to present in graphic or tabular form. Ask them to do so individually or as a group. Relatively complex relationships should be included in some of the exercises to challenge the more able students.

ACTIVITY: It's a Matter of Interpretation GRADE: Later (9-12)

Purpose: To provide students with practice in interpreting tables and graphs and analyzing given interpretations of them

Materials: Table or Graph and Note Cards or Paper Slips

Directions:

1. Present a relatively complex table or graph to the class.
2. Ask each student to write down five statements about the table or graph. Each statement may be either true or false and should be so marked. The statements must be of the following types.
   a. A single, numerical reading.
   b. A direct numerical comparison of two values.
   c. A comparison describing one value as a multiple or a factor of another.
   d. A generalized comparison (e.g., "is smaller," "is the largest") of two or more values.
   e. A general description of an overall trend or characteristic shown by the table or graph.

   As students become proficient at this activity, a computation requirement may be added to some of these categories.
3. Ask each student to copy his or her statements on note cards or slips of paper, indicating whether the statements are true or false on the back.
4. Then conduct a contest similar to a spelling bee, eliminating students as they give incorrect answers.

   Rules - The true or false answer appearing with each question will be deemed the official answer unless challenged. Any eliminated student, including a student who has just been declared wrong, may challenge an official answer and attempt to show that it is incorrect. (If an incorrect answer is not challenged, then the teacher should make the correction for all to hear.) The first student to call for a challenge is the official challenger. A successful challenge will reinstate the student into the contest. An unsuccessful challenge will give the student a penalty point that must be eliminated by a successful challenge before the student can challenge to be reinstated. (In practice, an incorrect challenge will generally have the effect of permanently eliminating the student, since chances for correct challenges will be rare. The rule is intended to discourage students from indiscriminate challenges.)

ACTIVITY: Flaky Formulas GRADE: Later (9-12)

Purpose: To provide students with a chance to demonstrate creativity and humor while giving practice in developing and using formulas

Materials: Paper and Pencil

Directions:

1. Ask each student to write at least one "flaky formula." A submitted formula must include a word description of its purpose and a detailed definition of each term, including measurement units or descriptions of measuring scales on which unusual characteristics (e.g., beauty, popularity, etc.) are to be measured. Typically, a flaky formula will deal with subjective qualities in a humorous, quasi-objective manner. The formula must "work" in the sense that it must result in a real numerical value when eligible values are substituted for its various terms. Otherwise, the formula does not need to correspond to real life.

   Example: The following "flaky formula" describes a student's chance of being elected class president:

   $$P = \frac{4p + 2a + c}{70}$$

   where P is likelihood of being elected,

   p is popularity voted on a scale of 1-10,

   a is appearance or looks rated on a scale of 1-10, and

   c is quality of campaign rated on a scale of 1-10

2. The class as a whole can participate in using the "flaky formulas" with various people or situations. Students can exchange formulas and use various numbers in deriving the solution to the "flaky formulas."

3. As a more serious alternative, ask the students to try to develop formulas to describe real events or activities.

   Examples: a. Cost of a restaurant meal including tip and tax

   b. Cost of a new carpet for a rectangular room

   Extensions of familiar formulas can also be used.

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Concepts GRADE: All

Test Item Description: Overview

For Concepts, the student is presented with displays of objects, geometric figures, charts, and graphs, maps, numbers, and mathematical expressions. The student uses the information presented to answer questions about counting, identifying equivalencies, establishing relationships, determining place value, and/or interpreting tables and graphs.

As grade levels increase, the test questions for each subskill become more difficult. The difficulty is controlled by the use of the SKILL KEYS presented in the following chart (for example, NATURE OF PROBLEM and COUNTING UNITS).

1. Counting - The student should be able to count larger numbers of objects and count by ones, twos, fives, tens, and so forth.

2. Identifying Equivalencies - The student should be able to identify equivalent forms of the same number. The types of numbers eligible and ranges of numbers become increasingly more difficult. In Grade 11, students must be able to identify the equivalent form of the measurêment unit and product price given.

3. Establishing Relationships - The student is confronted with comparisons which incorporate the symbols <, >, and =. The expressions initially contain no operational symbols but do so in the later grades. In Grade 11, students must be able to determine and compare unit prices.

4. Determining Place Value - The student should be able to translate words and numbers into symbols and vice versa. In the later grades, powers of ten and exponential form may be used. The eligible places (ones, tens, etc.) incorporate decimal fractions in the later grades.

5. Interpreting Tables and Graphs - This skill becomes more difficult in terms of the types of graphs, the number of graph/table dimensions, and whether or not computations must be performed in deriving the graph/table reading.

6. Recognizing Square Roots - The student should be able to recognize the square root of any perfect square of 100 or less. As this subskill is tested only at Grade 11, there is no increase in difficulty by grade level.

7. Using Formulas - The student should be able to substitute numerical values for symbols in order to solve mathematical problems. As this subskill is tested only at Grade 11, there is no increase in difficulty by grade level.

SUB.	SKILL KEYS	GRADE 1	GRADE 2	GRADE 3	GRADE 4[a]	GRADE 5[a]	GRADE 6	GRADE 7[a]	GRADE 8	GRADES 9-12
DETERMINING PLACE VALUE	NATURE OF PROBLEM	Expression containing words and numerals	Expression containing words and numerals	Expression containing words and/or numerals			Expression containing words, numerals, and/or powers of 10		Expression containing words, numerals, and/or exponential form	*See Grade 9-12 Supplement.*
	TYPES OF NUMBERS	2-digit whole numbers	2-3 digit whole numbers	2-3 digit whole numbers			3-4 digit whole numbers		4-5 digit whole numbers and decimals	
	PLACES	Ones	Ones, tens	Ones, tens, hundreds			Ones, tens, hundreds, thousands		One tens, hundreds, thousands, and decimal fractions	
INTERPRETING TABLES AND GRAPHS	NATURE OF PROBLEM	Not tested	Reading and using information from tables and graphs Level of interpretation higher than at previous grade	Reading and using information from tables and graphs Level of interpretation higher than at previous grade			Reading and using information from tables and graphs Level of interpretation higher than at previous grade		Reading and using information from tables and graphs Level of interpretation higher than at previous grade	
	TYPES OF TABLES AND GRAPHS		Picture or bar graphs No tables	Picture or bar graphs No tables			Picture, bar, or circle graphs No tables		Picture, bar circle, or line graphs Tables	
	TYPES OF NUMBERS		1 digit whole numbers	1-2 digit whole numbers			1-2 digit whole numbers		1-3 digit whole numbers	
	DIMENSIONS		Graphs: up to 4 X 4	Graphs: up to 6 X 6			Graphs: up to 10 X 10		Graphs: up to 12 X 12 Tables: up to 5 X 5	
	COMPUTATIONS REQUIRED		None	None			None		One	

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[a] Refer to the Suggested Measurement Strategy for the State Objective.

SKILL DIFFICULTY CHART

OBJECTIVE: Concepts GRADE: All

SUB.	SKILL KEYS	GRADE 1	GRADE 2	GRADE 3	GRADE 4[a]	GRADE 5[a]	GRADE 6	GRADE 7[a]	GRADE 8	GRADES 9-12
COUNTING	NATURE OF PROBLEM	Counting objects	Complete a sequence of numbers	Complete a sequence of numbers			Not tested		Not tested	*See Grade 9-12 Supplement.*
	COUNTING UNITS	10-25 objects	Whole numbers, 1-399	Whole numbers, 1-999						
IDENTIFYING EQUIVALENCIES	NATURE OF PROBLEM	Identifying equivalent forms of numbers	Identifying equivalent forms of numbers	Identifying equivalent forms of numbers			Identifying equivalent forms of numbers		Identifying equivalent forms of numbers	
	WORD NAME EQUIVALENTS	Word names of numbers 0-10	Word names of numbers 10-399	Word names of numbers 20-999			Word names of 3- or 4-digit numbers .001-999.9		Word names of numbers .001-9999.999	
	NUMERICAL EQUIVALENTS	Not tested	Fractions: halves, thirds, fourths, fifths	Fractions: thirds to twelfths			Decimals, fractions, mixed numbers, percents		Decimals, fractions, mixed numbers, percents, ratios	
ESTABLISHING RELATIONSHIPS	NATURE OF PROBLEM	Comparing sets of objects	Comparing whole numbers	Comparing whole numbers to arithmetic expressions			Comparing fractions		Comparing fractions	
	TYPE OF COMPARISON	One to one correspondence	Relational expression involving (<, >, =) and no operational symbols	Relational expression involving (<, >, =) and (+, -, x)			Relational expression involving (<, >, =)		Relational expression involving (<, >, =)	

[a] Refer to the Suggested Measurement Strategy for the State Objective.

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SKILL DIFFICULTY CHART
GRADE 9-12 SUPPLEMENT

OBJECTIVE: Concepts GRADE: 9-12**

SUBSKILL	SKILL KEYS	GRADES 9-12**
COUNTING	NOT TESTED	
IDENTIFYING EQUIVALENCIES	NATURE OF PROBLEM	Identifying equivalent forms of numbers displayed
	WORD NAME EQUIVALENTS	Display giving word names of dollar amounts between $.01 and $99,999.99
	NUMERICAL EQUIVALENTS	Display giving dollar amounts, decimals, fractions, percents, and ratios
	UNIT PRICES	Display giving a 1-to-2-digit whole number with measurement unit and the product price (e.g. 7 oz. at $.56)
ESTABLISHING RELATIONSHIPS	NATURE OF PROBLEM	Determination and comparison of unit prices
	TYPE OF COMPARISON	Relational: most expensive or least expensive
DETERMINING PLACE VALUE	NATURE OF PROBLEM	Expression containing numerals to be rounded to specified place value
	TYPES OF NUMBERS	2- to 6-digit decimals
	PLACES	Ones, tens, hundreds, thousands, and decimal fractions

**Tested at Grade 11

OBJECTIVE: Concepts GRADE: 9-12**

SUBSKILL	SKILL KEYS	GRADES 9-12**
INTERPRETING TABLES AND GRAPHS	NATURE OF PROBLEM	Reading and using information from tables and graphs. Graphs may require interpolation. Level of interpretation higher than at previous grade.
	TYPES OF TABLES AND GRAPHS	Line, bar, picture, or circle graphs
	DIMENSIONS	Graphs: n x n (except circle graphs) Line graph: 2-3 lines may appear in single graph Bar graph: 2-3 bars per category may appear in a single graph on either dimension
	TYPES OF NUMBERS	Decimals from .01 to 99.99 or integers from -100 to 50,000
	COMPUTATIONS	Maximum of 4 computations in graphs and tables (exception is tables greater than 12 x 12)
USING FORMULAS	NATURE OF PROBLEM	Using a given formula with a given set of numbers
	TYPE OF FORMULAS	Formulas may contain 1 to 6 variables or constants and 1-4 digit whole numbers or decimals, formulas involving rates not stated explicitly

**Tested at Grade 11

CN-0.21*

OBJECTIVE: Concepts GRADE: 9-12**

SUBSKILL	SKILL KEYS	GRADES 9-12**
RECOGNIZING SQUARE ROOTS	NATURE OF PROBLEM	Recognizing square roots
	TYPE OF NUMBERS	Perfect squares from 1 to 100
	NOTATION	Verbal form "square root of" or $\sqrt{}$

**Tested at Grade 11

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Concepts GRADE: 8

Objective

The student can apply numerical concepts.

Suggested Measurement Strategy

Answering questions about numerical quantities and representations. These questions may require comprehending mathematical symbols and terminology, identifying equivalent ways of expressing the same numerical quantity, establishing relationships between numerical quantities, estimating, determining place value, creating or comparing sets, using formulas, developing or interpreting graphs, using tables, or establishing ratios or proportions.

Subskills

The solid circles ● indicate the subskills tested. The open circles O indicate the subskills for you to consider in your instruction.

1. Counting

The student can count.

● 2. Identifying Equivalencies

The student can identify equivalent ways of expressing the same numerical quantity.

● 3. Establishing Relationships

The student can establish relationships between numerical quantities.

● 4. Determining Place Value

The student can determine the place value of numerical quantities.

● 5. Interpreting Tables and Graphs

The student can extract information from tables and graphs.

6. Recognizing Square Roots

The student can recognize common square roots.

7. Using Formulas

The student can apply formulas.

OBJECTIVE: Concepts **GRADE:** 8

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Comprehension of Numerical Representations

The student can interpret the numerical representations for whole numbers, fractions, decimals, and percents. For example, given the numerical representation "$\frac{2}{3}$", the student associates that symbol with the concept "two-third

○ 2. Comprehension of Mathematical Terminology

The student understands the following types of mathematical vocabulary: (1) the word forms for whole numbers, fractions, and decimals; (2) names referring to place value (for example, "hundredths place"); (3) relationship words (for example, "most," "least"); (4) sequencing words (for example, "before," "next"); and (5) phrases requiring the determination of a quantity (for example, "how much," "how many," "what part").

○ 3. Comprehension of Mathematical Symbols

The student understands the following types of symbols: (1) operational signs (for example, +, −, x, and ÷); (2) relations symbols (for example, =, <, and >); and (3) symbols used in conjunction with numbers (for example, decimal point, percentage sign, and exponent).

○ 4. Comprehension of Numerical Sequence

The student understands that numbers can be (1) arranged in ascending or descending order; (2) grouped by multiples and (3) counted forwards or backwards.

○ 5. Comprehension of Graphic Representations

The student understands that numerical quantities and data relationships can be represented either visually, (that is, in picture, circle, and bar graphs) or through a coordinate system of rows and columns (for example, in tables).

6. Comprehension of Unit Price (Grades 9-12 only)

Given the volume of a package and package price, the student can determine the unit price.

7. Interpolation (Grades 9-12 only)

The student understands the concept of interpolation as it applies to graphs.

CN-8.2

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE:	Concepts	GRADE: 8
SUBSKILL:	Identifying Equivalencies	

Sample Item and Directions

(Teacher reads.)

> Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

- -

(Student reads.)

$$\boxed{\frac{9}{12} = \frac{?}{16}}$$

What number makes the sentence true?

(A) 9

(B) 12 (correct)

(C) 10

(D) 8

Write Your Own Item
Use the back of this page.

CN-8.3

HOW SKILLS ARE TESTED

OBJECTIVE: Concepts GRADE: 8
SUBSKILL: Establishing Relationships

Sample Item and Directions

(Teacher reads.)

> Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)

$$\boxed{\underline{\quad ? \quad} < \frac{17}{45}}$$

What fraction makes this sentence true?

(A) $\frac{1}{3}$ (correct)

(B) $\frac{2}{3}$

(C) $\frac{2}{5}$

(D) $\frac{4}{9}$

Write Your Own Item
Use the back of this page.

HOW SKILLS ARE TESTED

OBJECTIVE: Concepts GRADE: 8
SUBSKILL: Determining Place Value

Sample Item and Directions

(Teacher reads.)

> Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)

> 4 ones 7 tens 6 hundredths 9 thousandths

What number is the same as the number in the box?

(A) 7.469

(B) 47.96

(C) 74.069 (correct)

(D) 9674

Write Your Own Item
Use the back of this page.

HOW SKILLS ARE TESTED

OBJECTIVE: Concepts GRADE: 8
SUBSKILL: Interpreting Tables and Graphs

Sample Item and Directions

(Teacher reads.)

> Read along silently as I read aloud the directions for all problems.

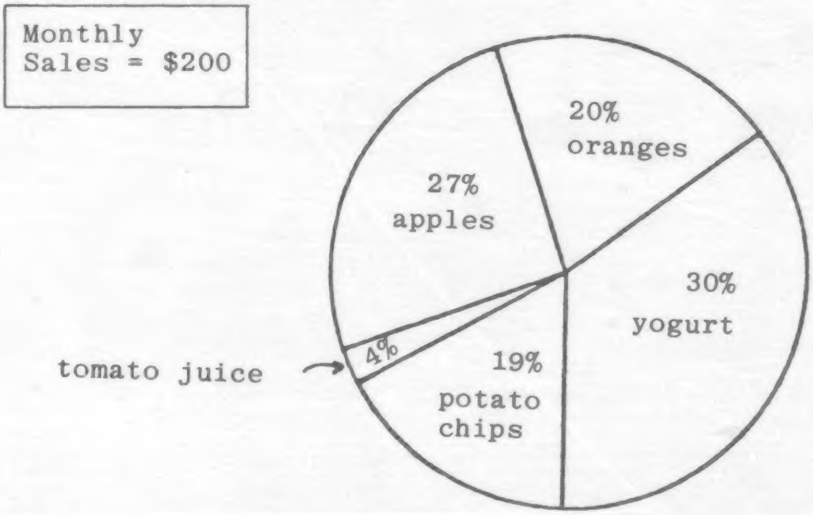
(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

- -

(Student reads.)

SOURCES OF VENDING MACHINE INCOME



How much money is made on tomato juice each month?

(A) $ .40
(B) $ .50
(C) $4.00
(D) $8.00 (correct)

Write Your Own Item
Use the back of this page.

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Concepts GRADE: 9-12**

Objective

The student can apply numerical concepts.

Suggested Measurement Strategy

Answering questions about numerical quantities and representations. These questions may require comprehending mathematical symbols and terminology, identifying equivalent ways of expressing the same numerical quantity, establishing relationships between numerical quantities, estimating, determining place value, creating or comparing sets, using formulas, developing or interpreting graphs, using tables, or establishing ratios or proportions.

Subskills

The open circles O indicate subskills for you to consider in your instruction. The solid circles ●, under the column labeled Grade 11, indicate the subskills tested at Grade 11.

GRADE: 9-12 GRADE: 11

1. Counting

   The student can count.

○ 2. Identifying Equivalencies ●

The student can identify equivalent ways of expressing the same numerical quantity.

○ 3. Establishing Relationships ●

The student can establish relationships between numerical quantities.

○ 4. Determining Place Value ●

The student can determine the place value of numerical quantities.

○ 5. Interpreting Tables and Graphs ●

The student can extract information from tables and graphs.

○ 6. Recognizing Square Roots ●

The student can recognize common square roots.

○ 7. Using Formulas ●

The student can apply formulas.

**Tested at Grade 11

OBJECTIVE: Concepts GRADE: 9-12**

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Comprehension of Numerical Representations

The student can interpret the numerical representations for whole numbers, fractions, decimals, and percents. For example, given the numerical representation "$\frac{2}{3}$", the student associates that symbol with the concept "two-thir

○ 2. Comprehension of Mathematical Terminology

The student understands the following types of mathematical vocabulary: (1) the word forms for whole numbers, fractions, and decimals; (2) names referring to place value (for example, "hundredths place"); (3) relationship words (for example, "most," "least"); (4) sequencing words (for example, "before," "next"); and (5) phrases requiring the determination of a quantity (for example, "how much," "how many," "what part").

○ 3. Comprehension of Mathematical Symbols

The student understands the following types of symbols: (1) operational signs (for example, +, -, x, and ÷); (2) relations symbols (for example, =, <, and >); and (3) symbols used in conjunction with numbers (for example, decimal point, percentage sign, and exponent).

○ 4. Comprehension of Numerical Sequence

The student understands that numbers can be (1) arranged in ascending or descending order; (2) grouped by multiple and (3) counted forwards or backwards.

○ 5. Comprehension of Graphic Representations

The student understands that numerical quantities and data relationships can be represented either visually, (that is, in picture, circle, and bar graphs) or through a coordinate system of rows and columns (for example, in tables).

○ 6. Comprehension of Unit Price (Grades 9-12 only)

Given the volume of a package and package price, the student can determine the unit price.

○ 7. Interpolation (Grades 9-12 only)

The student understands the concept of interpolation as it applies to graphs.

**Tested at Grade 11

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Concepts GRADE: 9-12**
SUBSKILL: Identifying Equivalencies

Sample Item and Directions

(Teacher/Student read.)

Directions:
1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)

What value is the same as the amount below?

Six hundred ninety-four and 09/100 dollars

(A) $694.09 (correct)

(B) $694.90

(C) $6904.09

(D) $6940.90

Write Your Own Item
Insert additional pages.

**Tested at Grade 11

CN-9.3

HOW SKILLS ARE TESTED

OBJECTIVE: Concepts GRADE: 9-12**
SUBSKILL: Establishing Relationships

Sample Item and Directions

(Teacher/Student read.)

Directions:
1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)

The costs of several brands of toothpaste are shown below. Which costs the most per ounce?

(A) 7 oz. for $1.19

(B) 9 oz. for $1.44

(C) 5 oz. for $.89 (correct)

(D) 11 oz. for $1.65

Write Your Own Item
Insert additional pages.

**Tested at Grade 11

HOW SKILLS ARE TESTED

OBJECTIVE: Concepts GRADE: 9-12**
SUBSKILL: Determining Place Value

Sample Item and Directions

(Teacher/Student read.)

Directions:
1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)

Round off 234.56 to the nearest tenth.

(A) 230.0

(B) 234.5

(C) 234.6 (correct)

(D) 235.0

Write Your Own Item
Insert additional pages.

**Tested at Grade 11

HOW SKILLS ARE TESTED

OBJECTIVE: Concepts GRADE: 9-12**
SUBSKILL: Interpreting Tables and Graphs

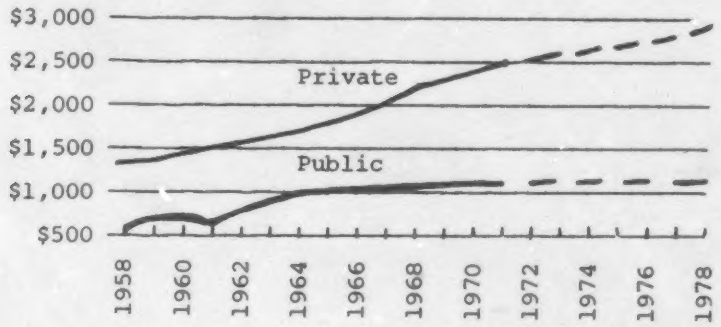
Sample Item and Directions

(Teacher/Student read.)

Directions:
1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)

Average Charges for College Tuition, Room and Board



In 1971 how much more did it cost to send a student to a private school than a public school?

(A) $1100

(B) $1400 (correct)

(C) $2400

(D) $2500

Write Your Own Item
Insert additional pages.

**Tested at Grade 11

HOW SKILLS ARE TESTED

OBJECTIVE: Concepts GRADE: 9-12**
SUBSKILL: Using Formulas

Sample Item and Directions

(Teacher/Student read.)

Directions:

1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)

The cost to insulate an attic is given by the formula:

$$\text{COST} = \frac{(\text{AREA} \times \text{THICKNESS})}{12.0}$$

AREA = the area of the attic in square feet
THICKNESS = the thickness of the insulation in inches
COST = cost in dollars

The area of an attic is 720 square feet. What would it cost to insulate the attic with 6 inches of insulation?

(A) $36

(B) $360 (correct)

(C) $738

(D) $4320

Write Your Own Item
Insert additional pages.

**Tested at Grade 11

HOW SKILLS ARE TESTED

OBJECTIVE: Concepts GRADE: 9-12**
SUBSKILL: Using Formulas

Sample Item and Directions

(Teacher/Student read.)

Directions:
1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)

A man walks 10 miles in 2.5 hours. What was his average speed in mph (miles per hour)?

(A) 2.5 mph

(B) 4.0 mph (correct)

(C) 12.5 mph

(D) 25.0 mph

Write Your Own Item
Insert additional pages.

**Tested at Grade 11

HOW SKILLS ARE TESTED

OBJECTIVE: Concepts GRADE: 9-12**
SUBSKILL: Recognizing Square Roots

Sample Item and Directions

(Teacher/Student read.)

Directions:

1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)

Find the square root of 81.

(A) 3

(B) 8

(C) 9 (correct)

(D) 27

Write Your Own Item
Insert additional pages.

**Tested at Grade 11

Operations

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NOTE: * - All pages contain the same information in all booklets in the T & T Mathematics series, except for asterisked (*) pages.

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Operations GRADE: All

Objective

The student can compute accurately.

Explanation

The ability to perform operations with various types of numbers represents a skill that permeates all of the mathematics objectives. This skill requires mastery of the basic arithmetic facts as well as familiarity with the operational algorithms for whole numbers, decimals, fractions, and percents.

Subskills: Overview

The subskills identified for testing this objective are listed in the chart. The symbol O is used to indicate that the subskill is not tested but needs to be considered instructionally. The symbol ● indicates that the subskill is tested.

SUBSKILLS	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Addition The student can add accurately.	●	●	●	O	O	●	O	●	O	O	●	O
2. Subtraction The student can subtract accurately.	●	●	●	O	O	●	O	●	O	O	●	O
3. Multiplication The student can multiply accurately.		O	●	O	O	●	O	●	O	O	●	O
4. Division The student can divide accurately.			●	O	O	●	O	●	O	O	●	O

OBJECTIVE: Operations GRADE: All

Other Important Skills: Overview

Instructionally, there are some other skills that must be considered in addition to those identified for testing under this objective. The symbol O is used to indicate that the skill is not tested but needs to be considered instructionally.

SKILLS	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Knowledge of Basic Number Facts The student can add, subtract, multiply, and divide all possible pairs of one-digit numbers.	O	O	O	O	O	O	O	O	O	O	O	O
2. Comprehension of Place Value The student can apply place value concepts when setting up and solving a problem.	O	O	O	O	O	O	O	O	O	O	O	O
3. Ability to Perform a Series of Computations The student can perform in a correct sequence all of the individual computations needed to solve a computational problem.	O	O	O	O	O	O	O	O	O	O	O	O
4. Ability to Regroup The student can regroup accurately as required by a problem. This includes knowing when in a computation to regroup, what quantity to regroup, and the place values of the numbers involved in the regrouping.		O	O	O	O	O	O	O	O	O	O	O
5. Understanding of Fractions The student can identify a fraction's numerator and denominator. The student knows how to manipulate each part of a fraction when performing a calculation with that number.		O	O	O	O	O	O	O	O	O	O	O
6. Ability to Operate with Fractions The student can find the lowest common denominator for two fractions, convert a fraction with one denominator, and reduce an improper fraction to its lowest terms.				O	O	O	O	O	O	O	O	O

WHAT ARE SOME IDEAS FOR ACTIVITIES

OBJECTIVE: Operations GRADE: All

Activities

On the following pages are some ideas for developing your own activities. These activities are intended only as examples to stimulate your thinking. The activities are not intended to be prescriptive. You can use these activities to help in building student skills.

For each activity, the purpose, the materials you need, and the directions are given. The activities are not designated by grade level since many of them can be adapted for use in earlier or later grades. You may wish to add worksheets and/or activities of your own.

Resources

Below is space for you to note resource materials appropriate for the grade(s) you teach.

Subskill	Resource Material
1. Addition	
2. Subtraction	
3. Multiplication	
4. Division	

ACTIVITY: Fun with Facts GRADE: Early

Purpose: To provide students with opportunities to review the basic number facts

Materials: Crossword puzzles, Blank Bingo Cards and Markers

EXAMPLE:

1) 3	2) 3	■	4) 1
5) 4	6) 5	■	8) 2

(etc.)

Across	Down
1) 3 x 11 = ____	1) 29 + 5 = ____
5) 23 + 22 = ____	2) 7 x 5 = ____
	4) 3 + 3 + 3 + 3 = ____

Directions:

Have students do activities such as the following for reviewing basic number facts.

1. Prepare crossword puzzles that have numbers instead of words for answers.

2. Have students fill in blank bingo cards with computational problems that result in an integer between 1-81 (for example, 6 - 2, 3 x 4, 8 + 6, 9 [illegible]). As numbers are called, students cover any squares on their card which result in that solution. Then play the game in reverse, with students entering integers on their cards and the caller reading out simple computational problems.

ACTIVITY: Picture That GRADE: Early

Purpose: To provide practice in solving simple pictorial fraction problems

Materials: Large Sheets of Paper

Directions

1. Distribute paper to each student.
2. Students are to draw a fraction problem in each section. For example, they might draw two squares, one divided into fourths with two fourths shaded and the other divided into fourths with one fourth shaded. Students also include a "+" or "-" operational sign.
3. On a separate sheet of paper (answer sheet) students record the numerical form of each problem and its correct answer (for example, $\frac{2}{4} - \frac{1}{4} = \frac{1}{4}$).
4. Students exchange their drawings and then try to solve each other's problems. Answers are checked against the answer sheets.

ACTIVITY: Going Backwards GRADE: Early

Purpose: To provide practice on basic operations skills

Materials: List of Numbers, Chalkboard

Write a list of numbers on the chalkboard. This list represents the answers for which students are to supply the problems. The answers may be whole numbers and/or proper fractions, depending upon the level of the class.

Directions:

1. Have students devise as many problems as they can that result in each answer given. These problems may require addition, subtraction, multiplication, or division.
2. Check each student's problems, to make sure they result in the answers given. Prizes could be awarded to the students who created the most number of correct problems.

OP-0.6

ACTIVITY: Related Operations GRADE: Later

Purpose: To promote understanding of the basic idea of multiplication and division sentences and teach the words associated with such sentences

Materials: Multiplication Cards

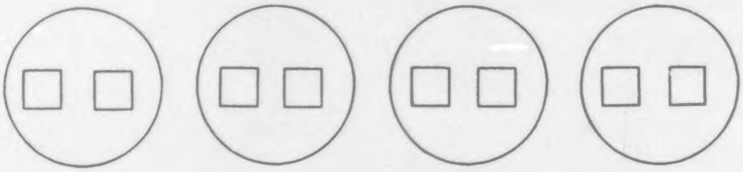
Directions:

1. For multiplication, make cards for the necessary words and symbols and then manipulate those cards to show a sentence.

   Example: FACTOR X FACTOR = PRODUCT

2. Then, relate the multiplication sentence to the models for multiplication.

   Example:



   4 sets of 2 is 8

   4 x 2 = 8

   FACTOR X FACTOR = PRODUCT

3. Follow a similar procedure with division, in this instance showing the relationship between the two operations.

   FACTOR X FACTOR = PRODUCT

   Example:

   PRODUCT ÷ FACTOR = FACTOR

4. Prepare exercises such as the following and instruct the class to write two related divison sentences for each multiplication sentence.

   a. 3 x 6 = 18
   b. 7 x 5 = 35
   c. 4 x 9 = 36
   d. 7 x 8 = 56

OP-0.7

ACTIVITY: Palindrome Puzzles GRADE: Later

Purpose: To provide practice in addition skills through the use of mathematical puzzles

Materials: Paper and Pencil

Directions:

1. Tell students they will be creating palindromes. A palindrome is a number that reads the same from left to right or right to left, for example, 121.
2. Have them begin by choosing any two or three digit number. Next they are to reverse the digits in that number and sum the two addends.
3. The process continues until the sum is a palindrome.

Example:

$$\begin{array}{r} 649 \\ +\ 946 \\ \hline 1595 \\ +\ 5951 \\ \hline 7546 \\ +\ 6457 \\ \hline 14003 \\ +\ 30041 \\ \hline 44044 \end{array}$$

ACTIVITY: Calamity Kid GRADE: Later

Purpose: To provide practice in completion of a series of calculations and to provide knowledge of commonly-occuring types of errors made in performing basic calculations

Materials: Written Sets of Basic Computational Problems

Prepare sets of basic computational problems at a level of difficulty appropriate for the content currently being studied by students. Each problem should be presented in a format that shows a solution plus all the calculations necessary to reach that solution.

Some of the problems should be worked correctly and some incorrectly. The incorrect solutions should be based on errors commonly made by students. These errors include incorrectly adding, subtracting, multiplying or dividing single digits, failing to regroup when necessary, regrouping when not necessary, incorrectly lining up digits, and performing the wrong operation.

Directions:

Have students check each problem and indicate whether it is correct or incorrect. Have students reword all incorrect problems so that they are correct. Students can also be asked to categorize the type of error occuring in each incorrect problem.

ACTIVITY: What's Possible GRADE: Later

Purpose: To provide practice for students in checking their calculational work

Materials: Word Problems

For each of several problems, write one or more proposed answers. The steps in arriving at the proposed answers to each problem may or may not be shown.

Directions:

1. Distribute copies of the problems to students. Do not allow students time to work the problems.

2. Have students indicate, for each problem, which of the proposed answers seem reasonable and which ones seem unreasonable.

3. Discuss with students the correct choices as well as strategies for approximating answers to calculational problems without actually computing an exact solution.

ACTIVITY: Name That Prime GRADE: Later

Purpose: To provide practice in finding prime numbers and least common denominators

Materials: Chalkboard

Directions:

1. Divide the class into two teams.

2. Place a group of numbers on the chalkboard as illustrated below.

1 13 5 8 18 4
3 9 15
2 14 6 12 17 11 10 16 7

3. Call out a number (for example, "35"). The first player on the first team reports all the prime factors for that number, using only the set available on the board. One point is scored for each factor named.

4. When the first player on the first team is finished, the first player on the other team has a chance to add any additional prime factors that have not been named or to dispute, as incorrect, any factors that have been named. Two points are scored for each correct addition or deletion this player makes.

5. Play continues to alternate between the two teams, with each one receiving an equal number of chances to respond first to the number called out by the teacher and to judge the correctness of another player's responses.

6. The set of factors to be considered can be changed frequently adding variety to the game.

7. Prime numbers alone may be used in this game as the numbers called out by the teacher. If they are included, any player who first identifies a number as a prime scores three points.

ACTIVITY: Take the Challenge GRADE: Later

Purpose: To provide practice in basic operations skills

Materials: Computation Exercise Sheets

On sheets of paper, list the kinds of problems that teams are to create. For example, the sheet might say: "Make up two multiplication problems. Each one must have two mixed numbers, neither one of which can be greater than 20. Each must have different denominators in the fractions. Neither denominator can be greater than 6."

Directions:

1. Divide the class into teams. Each team receives a computation exercise sheet.
2. Each team prepares the specified number of problems, along with an answer key.
3. Teams exchange problems and compete to see which team can solve all of the other team's problems most rapidly.
4. Answers are checked against the answer key provided and any disagreements arbitrated by the teacher or a panel of student judges chosen for this purpose.
5. The number and difficulty level of eligible computational problems can both be increased gradually over time.

ACTIVITY: Target Practice GRADE: Later (9-12)

Purpose: To develop accuracy of computation as well as an understanding of the order of operations

Materials: Deck of Cards

Make a deck of cards consisting of three sets of the numbers 1-10, two sets of the numbers 11-17, and one set of the numbers 18-25.

Directions:

1. Choose six cards at random from the deck. Then choose one of the six cards as the "target" number.
2. Ask students to combine the other five numbers in any sequence of operations using each number exactly one time in order to obtain the target number. (Some combinations may prove impossible, but the entire class should be given time to come up with a solution before restarting the exercise.)

Example: The numbers 1, 6, 2, 2, and 17 must be arranged to obtain the target number 8. One possible solution is:

$$17 - [(6 \times 2) - (2 + 1)] = 8.$$

ACTIVITY: Life Operations GRADE: Later (9-12)

Purpose: To provide opportunities for computational practice with monetary amounts in real-life situations

Materials: Consumer and Business Forms

Ask students to bring to class examples of checkbooks, sales slips, invoices, bills, and other consumer/business forms which require the use of mathematical operations.

Directions:

1. Collect the examples students bring to class and arrange these into groups which might conceivably occur in sequence in an individual's life.
2. Have a few students carry out the transactions implied by the forms and documents while the rest of the class checks all the operational computations involved.

Example: A paycheck is deposited into a checking account where there is already a balance. Several invoices and bills are then received and paid from the account, and a final balance is computed.

OP-0.14*

ACTIVITY: Casting Out Nines GRADE: Later (9-12)

Purpose: To provide practice in "casting out nines" and digital summing, which are useful as a lead-in to number theory as well as a handy method of checking computations involving large-digit numbers

Materials: Paper and Pencil

Directions:

1. The technique for addition and subtraction follows. When adding or subtracting two numbers, sum the digits of each number excluding nines, repeating the process with intermediate results until a number less than 9 is obtained.

```
Example:    23.49  --  2 + 3 + 4 =  9  --  0
          + 39.70  --  3 + 7     = 10  --  1
            63.19  --  6 + 3 + 1 = 10  --  1
```

2. For multiplication, perform the casting-out and the summing on the operands. Use the results to obtain a check-product to check against the sum of the digits in the product.

```
Example:    23.48  --  2 + 3 + 4 + 8     = 17  --  8  ---  8
          x 39.70  --  3 + 7             = 10  --  1  --  x 1
           164360
          2113200
          7044000
         932.1560  --  3 + 2 + 1 + 5 + 6 = 17  --  8  --   8
```

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Operations GRADE: All

Test Item Description: Overview

For Operations, the student is presented with a computational problem. The student must add, subtract, multiply, and/or divide to determine the answer to the problem.

As grade levels increase, the test questions for each subskill become more difficult. The difficulty is controlled by the use of the SKILL KEYS presented in the following chart (for example, TYPES OF NUMBERS). TYPES OF NUMBERS and algorithmic complexity (NUMBER OF REGROUPINGS, REDUCING REQUIRED, etc.) are the primary considerations. Students are expected to be able to perform the various computations regardless of format.

1. Addition - The student should be able to add using different types of numbers. As grade levels increase, the numbers of addends and regroupings may also increase.

2. Subtraction - The student should be able to subtract using different types of numbers. As grade levels increase, the number of regroupings, as well as the use of zeros may also increase.

3. Multiplication - The student should be able to multiply using different types of numbers. As grade levels increase, the number of factors and the number of regroupings, as well as the use of zeros and the number of digits in the multiplicand and multiplier may also increase.

4. Division - The student should be able to divide using different types of numbers. As grade levels increase, the types of numbers, as well as the use of zeros may also increase. Students are expected to be able to record remainders in various formats (whole number, fractional, and decimal remainders).

SUB.	SKILL KEYS	GRADE 1	GRADE 2	GRADE 3	GRADE 4[a]	GRADE 5[a]	GRADE 6	GRADE 7[a]	GRADE 8	GRADES 9-12
ADDITION	NUMBER OF ADDENDS	2-3	2-4	2-5			2-4		2-4	*See Grade 9-12 Supplement.*
	NUMBER OF REGROUPINGS	0	0-1	0-2			0-3		0-4	
SUBTRACTION	NUMBER OF REGROUPINGS	0	0-1	0-2			0-3		0-4	
MULTIPLICATION	NUMBER OF FACTORS	Not tested	Not tested	2			2-3		2-3	
	FORMAT			Horizontal or vertical			Horizontal or vertical		Horizontal or vertical	
	NUMBER OF DIGITS IN MULTIPLICAND AND MULTIPLIER			1-3 and 1			1-3 and 1-2		1-3 and 2	
DIVISION	REMAINDER?	Not tested	Not tested	Yes			Yes		Yes Fractional Remainders	
	FORMAT			Use of $\overline{)}$ sign			Use of both signs: $\overline{)}$ and ÷		Use of both signs: $\overline{)}$ and ÷	

[a] Refer to the Suggested Measurement Strategy for the State Objective.

OP-0.16*

SKILL DIFFICULTY CHART

OBJECTIVE: Operations GRADE: All

SUB.	SKILL KEYS	GRADE 1	GRADE 2	GRADE 3	GRADE 4[a]	GRADE 5[a]	GRADE 6	GRADE 7[a]	GRADE 8	GRADES 9-12
ALL SUBSKILLS	TYPES OF NUMBERS	Whole numbers, up to 2 digits (+ and - only)	Whole numbers, up to 3 digits (+ and - only)	Whole numbers, up to 3 digits Fractions, 1 digit per numerator/ denominator. (+ and - only)			Whole numbers, up to 3 digits Fractions, up to 2 digits per numerator/ denominator Decimals, up to 3 digits Mixed nos., up to 1 digit per numerator/ denominator		Signed integers, up to 2 digits Fractions, up to 2 digits per numerator/ denominator Decimals, up to 4 digits Mixed nos., up to 2 digits per numerator/ denominator Percents (x and ÷ only)	*See Grade 9-12 Supplement.*
	FORMAT	Horizontal or vertical	Horizontal or vertical	Horizontal or vertical			Horizontal or vertical		Horizontal or vertical	
	REDUCING REQUIRED?	No	No	No			Yes		Yes	
	FINDING COMMON DENOMINATOR REQUIRED?	No	No	No			No		Yes	

1/83

[a]Refer to the Suggested Measurement Strategy for the State Objective.

SKILL DIFFICULTY CHART
GRADE 9-12 SUPPLEMENT

OBJECTIVE: Operations GRADE: 9-12**

SUBSKILL	SKILL KEYS	GRADES 9-12**
ALL SUBSKILLS	NATURE OF PROBLEM	Nonverbal computational problem requiring addition, subtraction, multiplication, or division or Displays (such as deposit slips, invoices, etc.) which clearly indicate the nature of the operation to be performed may be included, extraneous data in displays permitted
	TYPES OF NUMBERS	Positive integers, up to 5 digits (+, -, x, and ÷) Negative integers, up to 2 digits (+ and - only) Fractions up to 2 digits per numerator/denominator (+, -, and x only) Decimals, up to 6 digits Mixed numbers, up to 2 digits per numerator/denominator (+, -, and x only) Percents containing 1-2 digit whole numbers (x and ÷ only)
	FORMAT	Horizontal or vertical Numbers may be in $0.00 format
	REDUCING FRACTIONS REQUIRED?	Yes (+, -, and x only)
	FINDING COMMON DENOMINATOR REQUIRED?	Yes (+ and - only)

**Tested at Grade 11

OBJECTIVE: Operations　　　　Grade: 9-12**

SUBSKILL	SKILL KEYS	GRADES 9-12**
ADDITION	NUMBER OF ADDENDS	2-4
	NUMBER OF DIGITS IN ADDENDS	See TYPES OF NUMBERS, ALL SUBSKILLS. Problems with signed integers limited to 1- to 2-digit numbers.
	NUMBER OF REGROUPINGS	No limits
SUBTRACTION	NUMBER OF DIGITS IN MINUEND AND SUBTRAHEND	See TYPES OF NUMBERS, ALL SUBSKILLS.
	NUMBER OF REGROUPINGS	No limits
MULTIPLICATION	NUMBER OF FACTORS	2 - 3
	NUMBER OF DIGITS IN MULTIPLICANDS AND MULTIPLIERS	Positive integers limited to 2- to 3-digits Decimals limited to 2- to 3-digits Percentage by a 1- to 3-digit positive integer or decimal
	NUMBER OF REGROUPINGS	No limits

**Tested at Grade 11

OP-0.18*

SKILL DIFFICULTY CHART
GRADE 9-12 SUPPLEMENT

OBJECTIVE: Operations GRADE: 9-12**

SUBSKILL	SKILL KEYS	GRADES 9-12**
DIVISION	NUMBER OF DIGITS IN DIVISOR AND DIVIDEND	1-2 digit positive integers, 1-2 digit decimal into a 2-4 digit decimal
	TYPE OF QUOTIENT	Quotients expressed as positive integers, terminating decimals, percents, or mixed numbers
	REMAINDER?	Yes
	NUMBER OF REGROUPINGS	No limits

**Tested at Grade 11

OP-8.1

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Operations GRADE: 8

Objective

The student can compute accurately.

Suggested Measurement Strategy

Determining the answers to exercises requiring a mathematical operation. The exercises to be solved may require adding, subtracting, multiplying, or dividing whole numbers, signed numbers, fractions, mixed numbers, decimals, or percents.

Subskills

The solid circles ● indicate the subskills tested. The open circles O indicate the subskills for you to consider in your instruction.

● 1. Addition

The student can add accurately.

● 2. Subtraction

The student can subtract accurately.

● 3. Multiplication

The student can multiply accurately.

● 4. Division

The student can divide accurately.

OBJECTIVE: Operations GRADE: 8

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Knowledge of Basic Number Facts

The student can add, subtract, multiply, and divide all possible pairs of one-digit numbers.

○ 2. Comprehension of Place Value

The student can apply place value concepts when setting up and solving a problem.

○ 3. Ability to Perform a Series of Computations

The student can perform in a correct sequence all of the individual computations needed to solve a computational problem.

○ 4. Ability to Regroup

The student can regroup accurately as required by a problem. This includes knowing when in a computation to regroup, what quantity to regroup and the place values of the numbers involved in the regrouping.

○ 5. Understanding of Fractions

The student can identify a fraction's numerator and denominator. The student knows how to manipulate each part of a fraction when performing a calculation with that number.

○ 6. Ability to Operate with Fractions

The student can find the lowest common denominator for two fractions, convert a fraction with one denominator, and reduce an improper fraction to its lowest terms.

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Operations
SUBSKILL: Addition
GRADE: 8

Sample Item and Directions

(Teacher reads.)

> Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)

$$\boxed{\begin{array}{r} 6 \\ \frac{2}{10} \\ +\ 1\ \frac{3}{5} \\ \hline \\ \end{array}}$$

(A) $7\frac{1}{2}$

(B) $7\frac{1}{3}$

(C) $7\frac{4}{5}$ (correct)

(D) 8

Write Your Own Item
Use the back of this page.

HOW SKILLS ARE TESTED

OBJECTIVE: Operations
SUBSKILL: Subtraction

GRADE: 8

Sample Item and Directions

(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)

372.1 - 8.75 = ____

(A) 284.6

(B) 363.35 (correct)

(C) 363.45

(D) 384.85

Write Your Own Item

Use the back of this page.

HOW SKILLS ARE TESTED

OBJECTIVE: Operations GRADE: 8
SUBSKILL: Multiplication

Sample Item and Directions

(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

- -

(Student reads.)

30% of 2.4 = ____

(A) .72 (correct)

(B) .8

(C) 1.5

(D) 8

Write Your Own Item
Use the back of this page.

HOW SKILLS ARE TESTED

OBJECTIVE: Operations GRADE: 8
SUBSKILL: Division

Sample Item and Directions

(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)

5 is what percent of 20?

(A) 4%
(B) 20%
(C) 25% (correct)
(D) 40%

Write Your Own Item
Use the back of this page.

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Operations GRADE. 9-12**

Objective

The student can compute accurately.

Suggested Measurement Strategy

Determining the answers to exercises requiring a mathematical operation. The exercises to be solved may require adding, subtracting, multiplying, or dividing whole numbers, signed numbers, fractions, mixed numbers, decimals, or percents, or extracting square roots.

Subskills

The open circles O indicate subskills for you to consider in your instruction The solid circles ●, under the column labeled Grade 11, indicate the subskills tested at Grade 11.

GRADE: 9-12			GRADE: 11
○	1.	Addition The student can add accurately.	●
○	2.	Subtraction The student can subtract accurately.	●
○	3.	Multiplication The student can multiply accurately.	●
○	4.	Division The student can divide accurately.	●

**Tested at Grade 11

OBJECTIVE: Operations GRADE: 9-12

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Knowledge of Basic Number Facts

The student can add, subtract, multiply, and divide all possible pairs of one-digit numbers.

○ 2. Comprehension of Place Value

The student can apply place value concepts when setting up and solving a problem.

○ 3. Ability to Perform a Series of Computations

The student can perform in a correct sequence all of the individual computations needed to solve a computational problem.

○ 4. Ability to Regroup

The student can regroup accurately as required by a problem. This includes knowing when in a computation to regroup, what quantity to group and the place values of the numbers involved in the regrouping.

○ 5. Understanding of Fractions

The student can identify a fraction's numerator and denominator. The student knows how to manipulate each part of a fraction when performing a calculation with that number.

○ 6. Ability to Operate with Fractions

The student can find the lowest common denominator for two fractions, convert a fraction with one denominator, and reduce an improper fraction to its lowest terms.

OP-9.2

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Operations
SUBSKILL: Addition

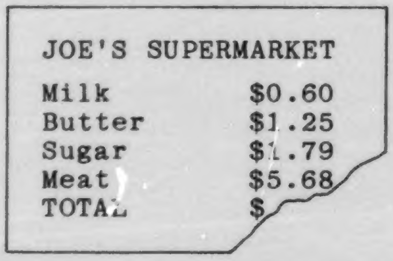
GRADE: 9-12**

Sample Item and Directions

(Teacher/Student read.)

Directions:
1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)



JOE'S SUPERMARKET

Milk	$0.60
Butter	$1.25
Sugar	$1.79
Meat	$5.68
TOTAL	$

The bottom portion of your market receipt was torn off by mistake. What was the total amount of your purchase?

Add the items to find the total.

(A) $3.64

(B) $8.72

(C) $9.32 (correct)

(D) $10.32

Write Your Own Item
Insert additional pages.

**Tested at Grade 11

HOW SKILLS ARE TESTED

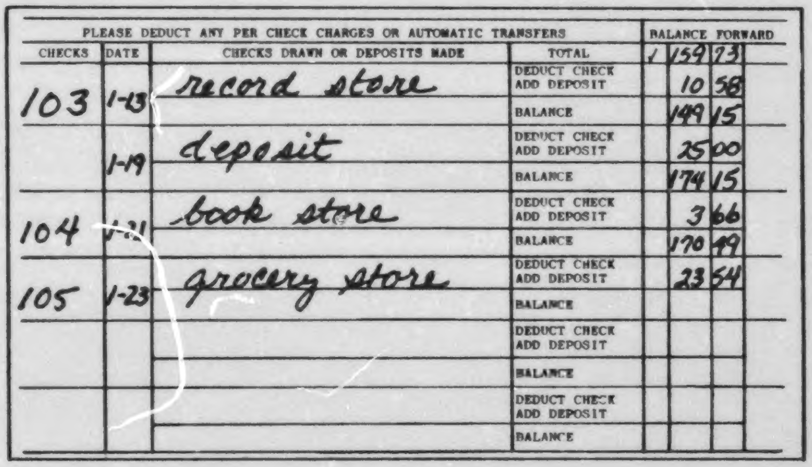
OBJECTIVE: Operations GRADE: 9-12**
SUBSKILL: Subtraction

Sample Item and Directions

(Teacher/Student read.)

Directions:
1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)



PLEASE DEDUCT ANY PER CHECK CHARGES OR AUTOMATIC TRANSFERS				BALANCE FORWARD		
CHECKS	DATE	CHECKS DRAWN OR DEPOSITS MADE	TOTAL	/	159	73
103	1-13	record store	DEDUCT CHECK ADD DEPOSIT		10	58
			BALANCE		149	15
	1-19	deposit	DEDUCT CHECK ADD DEPOSIT		25	00
			BALANCE		174	15
104	1-21	book store	DEDUCT CHECK ADD DEPOSIT		3	66
			BALANCE		170	49
105	1-23	grocery store	DEDUCT CHECK ADD DEPOSIT		23	54
			BALANCE			
			DEDUCT CHECK ADD DEPOSIT			
			BALANCE			
			DEDUCT CHECK ADD DEPOSIT			
			BALANCE			

Your personal check record is shown above. How much money is left in your checking account? (Subtract the last check shown from the last balance shown.) (170.49 - 23.54)

(A) $146.95 (correct)

(B) $153.15

(C) $193.93

(D) $194.03

Write Your Own Item
Insert additional pages.

**Tested at Grade 11

HOW SKILLS ARE TESTED

OBJECTIVE: Operations GRADE: 9-12**
SUBSKILL: Multiplication

Sample Item and Directions

(Teacher/Student read.)

Directions:
1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)

33% of $1.35 is _____ (round off to nearest cent)

(A) $.41

(B) $.45 (correct)

(C) $1.02

(D) $1.68

Write Your Own Item
Insert additional pages.

**Tested at Grade 11

HOW SKILLS ARE TESTED

OBJECTIVE: Operations
SUBSKILL: Division

GRADE: 9-12**

Sample Item and Directions

(Teacher/Student read.)

Directions:
1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)

The drama club has 25 members. Fifteen of the club's members are seniors. What percent of the club's members are seniors? (15 is what percent of 25?)

(A) 1.67%

(B) 37.5%

(C) 60.0% (correct)

(D) 375.0%

Write Your Own Item
Insert additional pages.

**Tested at Grade 11

Measurement

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TEACHING OUR SKILLS

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TEACHING OUR SKILLS

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NOTE: * - All pages contain the same information in all booklets in the T & T Mathematics series, except for asterisked (*) pages.

ME-0.2

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Measurement GRADE: All

Objective

The student can apply measurement concepts.

Explanation

Through the development of measurement skills, students can gather information about the world in which they live. These skills might first be developed using direct experiences involving measurable properties such as time, temperature, distance, weight, and volume. Students can begin to shape their expectations about the physical world through exploration and estimation of these properties. Later, students can investigate specific measurement tools and systems and find out about the appropriateness of various devices and measurement units for given situations they encounter. Estimation may be used as a means of determining if the results of their investigations are feasible. This skill should provide students with a powerful tool that they can use throughout their lives.

Subskills: Overview

The subskills identified for testing this objective are listed in the chart. The symbol O is used to indicate that the subskill is not tested but needs to be considered instructionally. The symbol ● indicates that the subskill is tested.

SUBSKILLS	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Identifying Units of Measurement The student can determine the appropriate type of measurement and select the appropriate units of measurement within a given measurement system.	●	●	●	O	O	●	O	●	O	O	●	O
2. Estimation The student can estimate measurable quantities within a given measurement system.		O	●	O	O	●	O	●	O	O	●	O
3. Using Measuring Devices The student can read and interpret information by using a measuring device within a given measurement system.	●	●	●	O	O	●	O	●	O	O	●	O
4. Conversions and Operations The student can make necessary conversions using units of measurement within a given measurement system and can perform calculations which may involve conversions.		O	●	O	O	●	O	●	O	O	●	O
5. Scale Drawings The student can read, interpret, and construct scale drawings within a given measurement system.				O	O	●	O	●	O	O	●	O

BEST COPY AVAILABLE

OBJECTIVE: Measurement GRADE: All

Other Important Skills: Overview

Instructionally, there are some other skills that must be considered in addition to those identified for testing under this objective. The symbol O is used to indicate that the skill is not tested but needs to be considered instructionally.

SKILLS	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Interpretation of Pictured Measuring Devices The student can "read" representations of the various measuring devices (for example, clocks, scales, rulers, thermometers, etc.).	O	O	O	O	O	O	O	O	O	O	O	O
2. Comprehension of Measurement Situations The student can analyze a situation described pictorially and/or verbally to determine, from the information given, what quantity or property is to be measured. This requires familiarity with the words used to describe measurable attributes (for example, "tall", "wide", "warm", "heavy", etc.).	O	O	O	O	O	O	O	O	O	O	O	O
3. Knowledge of Measurement Units, Abbreviations, and Symbols The student can recognize measurement units, symbols, and abbreviations and can associate each with a physical attribute it describes as well as a measurement device. For example, kilograms are a measure of weight determined by using a scale.	O	O	O	O	O	O	O	O	O	O	O	O
4. Selection of Appropriate Measurement Units The student can differentiate among the various units used to measure a particular attribute and recognize when each unit is most appropriate to use. For example, miles, not inches, are more appropriately used to measure long distances.		O	O	O	O	O	O	O	O	O	O	O
5. Knowledge of Measurement Equivalents The student knows measurement equivalents (for example, 12 inches = 1 foot, 60 seconds = 1 minute). This skill includes the ability to identify the larger/smaller unit of measure.		O	O	O	O	O	O	O	O	O	O	O
6. Determination of Measurement Plausibility The student is familiar with the physical properties of common objects and events so that the student can judge the reasonableness of estimations of those properties.			O	O	O	O	O	O	O	O	O	O
7. Interpretation of Scaled Measurement The student understands the concept of "scale distance" versus "actual distance" and can distinguish on a scale drawing between the units used to measure each.				O	O	O	O	O	O	O	O	O

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WHAT ARE SOME IDEAS FOR ACTIVITIES

OBJECTIVE: Measurement GRADE: All

Activities

On the following pages are some ideas for developing your own activities. These activities are intended only as examples to stimulate your thinking. The activities are not intended to be prescriptive. You can use these activities to help in building student skills.

For each activity, the purpose, the materials you need, and the directions are given. The activities are not designated by grade level since many of them can be adapted for use in earlier or later grades. You may wish to add worksheets and/or activities of your own.

Resources

Below is space for you to note resource materials appropriate for the grade(s) you teach.

Subskill	Resource Material
1. Identifying Units of Measurement	
2. Estimation	
3. Using Measuring Devices	
4. Conversions and Operations	
5. Scale Drawings	

ACTIVITY: Let's Find Out GRADE: Early

Purpose: To provide students with experience in judging the relative magnitudes of objects and events

Materials: Chart

Directions:

The activities below can be used to help students with their measurement skills.

1. Have students select a motor activity to perform (for example, hopping 20 times or clapping their hands 50 times). Before performing the activity, students estimate how long it will take to complete. After writing down their estimates, students take turns timingeach other, then compare their estimates with the actual times.

2. Prepare a chart with headings that correspond to the various units that can be used to measure the same attribute (for example, 1 inch, 1 foot, and 1 yard; 1 ounce and 1 pound). Students first list those objects in the classroom they estimate are in each category, then measure each object to verify their approximations.

3. Have students identify some events and objects,the magnitudes of which they would like to know (for example, the weight of an elephant, the height of the tallest building in the United States, the temperature inside a pizza oven). Then have them try to figure out a way to obtain the desired information (for example, ask someone, write a letter, use an encyclopedia). Assign individual students the responsibility for finding out each answer. Students might enjoy publishing a newspaper with their findings so that they can share their efforts with other classes.

ACTIVITY: Draw It GRADE: Early

Purpose: To provide practice with skills that sharpen direction-following while also testing knowledge of specific measurement devices

Materials: Drawing Paper and Pencils or Crayons

Directions:

1. Supply students with drawing paper and pencils or crayons, then present a series of written or verbal directions.
2. Each set of directions should require students to draw a specified measuring device showing a designated measurement (for example, draw a clock that shows 10 a.m.; draw a cup that has 1/4 cup of milk in it; draw a thermometer that shows 50°C).
3. When students complete their drawings, they can exchange papers and check each other's work.

ACTIVITY: A New System GRADE: Early

Purpose: To broaden the concept of measurement by using non-standard measuring systems

Materials: Sticks of Two Lengths and Different-Sized Small Cans

Directions:

1. Make available sticks of two lengths. The sticks should not have markings of any kind. Students, working in pairs, are to measure the length of a designated object (for example, the chalk tray) using the longer stick. Students also are to name their new stick unit.

2. Next, have students measure the width of the room using the longer stick. Then they should repeat the activity using the shorter stick.

3. Have students compare and discuss their results, then decide which stick length is the more practical to use for each set of measurements.

4. Follow up on the activity above using groups of three or four students working together to measure various classroom objects or distances taped along the floor. Ask the groups to record their measurements, then have the groups compare results and answer questions.

   Example: "Is a measurement in short sticks equal to the same measurement in long sticks?"

   "Which stick is more practical for each job?"

5. Select an object for measurement that does not allow the stick length to fit an even number of times. Have students estimate the amount of the unit left over and lead them to the idea of rounding to the nearest whole unit.

6. Prepare an analogous activity to measure liquid. Use different sizes of small cans and sand or water. Conduct the same types of discussions about comparisons, practicality, and rounding, as outlined above for stickunits.

ME-0.7

ACTIVITY: Units of Measurement GRADE: Later

Purpose: To provide students with practice in determining the appropriate unit of measure to use when determinig time, length, weight, volume, temperature, and area

Materials: Chalkboard

Directions:

1. As a class, make a list of measuring units available for each property to be studied, using either metric or customary units. Display the information, ordered from smaller to larger units, on the chalkboard or in a poster.

   Example: Length

   inch, foot, yard, mile; or
   millimeter, centimeter, meter, kilometer

2. Divide the class into small groups and appoint a recorder in each group.

3. Assign a measurable property and its measurement units to each group. The group's task is to think of objects that would most likely be measured in each unit.

   Example: Length

   Inch - pencil, book, paper clip
   Foot - car, tree, building
   Yard - length of the hallway
   Mile - highway distance

4. Call time after a predetermined number of minutes and have groups take new properties and start once again. All groups are to cover all properties.

5. When the activity is completed, groups should share their lists and compile a master list.

ACTIVITY: Conversion Matches GRADE: Later

Purpose: To provide practice converting between simple and compound measurements

Materials: Two Sets of Cards

Make one card deck, each card of which states a specified time, length, weight or volume (for example, 1 hour, 10 minutes).

Make a second card deck, each card of which matches a quantity specified in the first set of cards but describes that quantity in larger or smaller units (for example, 70 minutes).

Combine the two sets of cards into one deck. Shuffle well.

Directions:

1. Ask students to find the quantities that make a match.
2. Students should check each other's work to insure that the correct matches were made.

ACTIVITY: Long List GRADE: Later

Purpose: To promote understanding of various measurement usages

Materials: None

Directions:

1. Establish categories for places where measurement devices and concepts are frequently used (for example, home, school, work, recreation, travel).
2. Students, working alone or in groups, are to research the measurement devices and applications associated with each category, then report on these to the rest of the class.
3. As an option, students might be assigned to prepare a report on unusual measurement devices (that is, ones that have not been studied already in class).

ACTIVITY: Scaling It GRADE: Later

Purpose: To provide practice in preparing scale drawings which require students to apply several different measurement skills

Materials: Paper and Pencil

Directions:

1. Have students prepare scale drawings of common objects, using an agreed-upon scale for all of their drawings (for example, 1 cm = 1 m). Students exchange drawings, then verify the work of others.

2. Ask students to make several scale drawings of the same place (for example, their bedrooms or the school yard). Each drawing should use a different scale ratio (for example, 1 inch = 1 foot, 1 inch = 2 feet, 1 inch = 1 yard). Have students compare their drawings and comment upon which scale ratio seemed most appropriate and why.

3. Have students apply the concept of scale to other measurable attributes. For example, if 1 sec. = 1 min., how long would an hour television show be if it were reduced to scale?

4. Locate or prepare a series of scale drawings and maps. Remove the scale ratio from each but leave on the indicators of actual length or distance. For instance, a map might be labeled to show the distance, in miles, between major cities. Provide students with rulers and have them determine the scale ratio that was used to prepare each drawing or map.

ME-0.10*

ACTIVITY: Estimation GRADE: Later (9-12)

Purpose: To gain familiarity with units of measurement (customary and metric) by measuring an assortment of physical objects

Materials: Measurement Devices

Ask students to collect and bring to class objects of different sizes that are used or seen in everyday life. Collect as many as possible of the following measurement devices.

A meter ruler marked in millimeters and centimeters

A yardstick graduated in 1/8ths

A foot ruler graduated in 1/16ths

A graduated cylinder marked in ml

A cup graduated in 1/4 cups and 1/3 cups

A scale from 1-200 lbs. graduated in lbs.

A scale from 1-100 kg graduated in kg

A balance scale that measures to nearest gram, ounce

A gallon container

A liter container

A micrometer or vernier calipers (.001 inch or .05 mm)

Directions:

1. Ideally, give every student an opportunity to measure each of several objects, using the entire spectrum of measuring devices appropriate to each object and recording the results.
2. Chart on the board the students' individual readings. Note the degree of variation for each measuring device and obtain an average reading.
3. Use this data to discuss the difficulties and/or advantages of taking measurements with a given device, and make a judgment as to the most appropriate device for measuring a particular object.

4. Possible questions for discussion following this activity are listed below.

   a. For an abitrary unit of measurement (using standard measuring devices), what is the smallest and/or largest object that could be measured?

   b. Under what circumstances would an object need to be measured with great accuracy? What types of skills or occupations would require the ability to measure accurately?

   c. How accurate or reliable are the measuring devices that you are using? How would you go about calibrating the measuring devices?

ACTIVITY: Tank Battle GRADE: Later (9-12

Purpose: To provide practice in estimating and verifying linear measurements.

Materials: Playing Board, Markers, Ruler, and Die

1. Playing Board - For a playing board, a square sheet of cardboard can be divided into small regular or irregular regions. A dot should be placed in the approximate center of each region. Square or rectangular grids are useful, as are hexagonal grids of the type available for use in fantasy, role-playing, or war games. A variety of boards with different-sized and -shaped regions should be made up.

2. Markers - Use two different-colored playing pieces small enough to fit inside the various regions on the playing board for markers.

3. Ruler - The ruler must be marked in metric or customary units and be at least as long as the diagonal of the playing board.

4. Die - One die is needed for each pair of players.

Directions:

1. Provide each pair of students with the following materials: playing board, markers, ruler, and one die.

2. Students face each other across the playing board. Each student places his or her marker on any region along the edge of the board nearest himself or herself. Markers represent enemy tanks that must estimate the distance to the opponent's tank in order to fire on it.

3. The first player calls out an estimate of the distance to the opposing tank in the agreed-upon units (generally inches/fractions of inches, or centimeters/millimeters). The estimate is recorded. The actual distance is measured from the dot in the center of the region in which the opposing tank is located. If any part of the region in which the opposing tank is located is at the specified distance, the firing player scores a hit.

4. After a player fires, he or she rolls the die and moves his or her tank the specified number of regions in any direction. The opposing player then calls out an estimate and proceeds as in Step 2. The first player to score 5 hits wins.

ACTIVITY: In My Estimation... GRADE: Later (9-12)

Purpose: To provide students with an opportunity to make a variety of measurement estimates

Materials: Paper, Pencil, and Ruler

Directions:

1. Each student in turn calls out something to be measured and an appropriate unit of measure. This may be a property of an object in the classroom or a duration of an event that can occur in the classroom. All students write down estimates of the required measurements.

2. When all estimates have been made, actual measurements are taken.

3. Students are awarded points as follows: 5 points for the closest estimate(s) (there may be a tie), 3 points for the second closest estimate(s), and 1 point for the third closest estimate(s). If the named property cannot be directly measured or calculated by known formulas, as in the case of the area of an irregular figure, students should suggest methods for obtaining the best possible approximation of the value. If the class cannot agree on a satisfactory approximation, no points are awarded for that measurement. The student who collects the most points wins.

4. An extension of this activity would be to include estimates of weights and volumes.

ME-0.13*

ACTIVITY: The Size is Right GRADE: Later (9-12)

Purpose: To allow students to compete with one another in using estimation skills

Materials: Paper and Pencil

Directions:

1. Three students are chosen to be the first contestants. They are shown an object and asked to estimate a measurable property of that object. They may or may not have the opportunity to handle the object or observe it at close range (to be decided and agreed upon by the class).

2. Contestants have two phases of estimation. In the first phase, each contestant writes an independent estimate and then reveals it after all contestants have made their estimates. In the second phase, each contestant has the opportunity to revise the estimate upward or to pass. A limit should be placed on the precision of the estimates so that the differences between estimates are greater than the error present in actual measurement. For example, linear estimates might be required to be given to the nearest half-inch or whole centimeter.

3. The object is then measured or a measurement previously determined by the teacher (in the interest of scoring time) is revealed. The contestant who comes closest to the actual measure, without exceeding it, wins the round. The two losers are replaced by two new contestants for the next round.

ACTIVITY: Time to Regroup GRADE: Later (9-12)

Purpose: To provide practice in performing operations on compound measures

Materials: None

Directions:

1. Students tell a cumulative story using compound measurement units according to the following "rules."

   a. Each student is to tell a story incident that suggests addition, subtraction, or multiplication of compound measures. The student who begins the story must provide two values. Later students may use the solution to the previous "problem" as one value, or may provide two new values.

   b. Each story incident must end with a phrase that leads up to a solution to the "problem." The storyteller must then pause to allow time for other students to work the problem. (Pencil and paper may be used.) Some sort of timing device may be used to insure fairness. After the pause, the storyteller calls on another student.

2. The student called on must respond at once with the solution to the "problem." If the student fails to respond immediately, or if another student can show that the given value is incorrect, he or she loses a scoring point or pays a previously agreed-upon "forfeit." The student must then continue the story with a new value or values as described in Item (b) above.

Example: Here is an example of the beginning of a story:

Fred: John was making drapes. He needed three panels of cloth, each 6 feet 10 inches long. So he went to the store and asked for....(pause)....Tina.

Tina: 20 feet 6 inches of cloth. Then he remembered he needed an extra 1 foot 6 inches for hems, so he told the clerk to measure....(pause)....Tony.

Tony: 22 feet instead. He paid for the cloth. On his way home, he stopped and bought 2 gallons and 1 quart of milk. When he got home, he found he already had 1 gallon and 2 quarts of milk. So he figured he had....(pause)....

ACTIVITY: Scaling, Scaling GRADE: Later (9-12)

Purpose: To provide students with an opportunity to make practical use of scale drawings along with other mathematical skills

Materials: Scale Drawings of Building Projects, Materials List, Estimate Form, Local Street Maps, and Telephone Directories

The scale drawings should indicate the materials from which the project is to be made (e.g., 3/4" plywood, 2" x 4" pine) but should not give dimensions directly. Drawings can be adopted from plans in magazines or books. A list of hardware and other materials not obvious in the drawings should also be included. The estimate form should include headings for quantities of materials, unit costs of materials, total costs of materials, mileage to obtain materials, travel costs to obtain materials at a specified cost per mile, labor cost estimates, etc. Also provide local street maps and telephone directories.

Directions:

1. Divide the class into several teams. Each team will represent a construction company which will bid on a given project.

2. Provide each team with a set of scale drawings of a simple building project, such as a bookcase or patio table. All teams should be given identical drawings.

3. Provide teams with the estimate form on which to figure out costs.

4. Have each team make a bid on the project. Teams must use the scale drawings to determine the dimensions necessary for figuring material quantities and the maps to determine driving distances to various suppliers. You may require students to actually call or visit suppliers to find out prices, or you may provide a list of suppliers with prices given for the different materials required by the projects.

5. The team giving the lowest accurate bid wins. You may want to establish some guidelines for labor and incidental costs to be sure that they are within reason.

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Measurement GRADE: All

Test Item Description: Overview

For Measurement, the student must be familiar with measurement units and devices in order to find the exact or most reasonable answer to the question. The questions may require identifying measurement units, estimation, using measurement devices, performing conversions and operations, and using scale drawings.

As grade level increases, the test questions for each subskill become more difficult. The difficulty is controlled by the use of the SKILL KEYS presented in the following chart (for example, MEASUREMENT SYSTEMS, TYPES OF UNITS, etc.). Students should be able to perform all skills within the same measurement system, customary or metric.

1. Identifying Units of Measure - The student should be able to select the most appropriate unit of measure for measuring a given object named or pictured. The types of measurement units eligible for testing vary as grade levels increase.
2. Estimation - The student should be able to estimate measurable quantities such as size, time, and weight. The types of measurement units eligible for testing vary as grade levels increase.
3. Using Measuring Devices - The student should be able to read and interpret information from a measuring device. Discriminations in readings become increasingly more refined.
4. Conversions and Operations - The student should be able to initially convert units of measurements and then regroup with units; and finally, in later grades perform calculations involving conversions within the same system. The eligible conversions increase with grade level.
5. Scale Drawings - The student is presented with a scale drawing such as a map, floor plan, or blueprint. The student should be able to read the scale and provide the actual measure and vice versa. As grade levels increase, the scale factor may require the use of fractional units.

SUB.	SKILL KEYS	GRADE 1	GRADE 2	GRADE 3	GRADE 4[a]	GRADE 5 a	GRADE 6	GRADE 7 a	GRADE 8	GRADES 9-12
CONVERSIONS AND OPERATIONS	NATURE OF PROBLEM	Not tested	Not tested	Converting from one unit to another in the same system			Converting from one unit to another in the same system		Computing (+, -, or x) with units in the same system (customary or metric) Compound Measurement for customary eligible	*See Grade 9-12 Supplement.*
	TYPES OF NUMBERS			Not tested			Customary: 1- or 2-digit integers, or fractions or mixed numbers with 1-digit numerators and denominators Metric: 1- to 3-digit decimals		Customary: 1-2 digit integers Metric: 1- to 2-digit integers	
	REGROUPING REQUIRED?			No			Yes, from one unit of measure to antoher		Yes, from one unit of measure to another	
SCALE DRAWINGS	NATURE OF PROBLEM	Not tested	Not tested	Not tested			Reading maps, floor plans, or blueprints		Reading maps, floor plans, or blue prints	
	SCALE CONVERSIONS						Customary: inches (scale) to feet or miles (actual) Metric: centimeters (scale) to meters or kilometers (actual)		Customary: inches (scale) to feet or miles (actual) Metric: centimeters (scale) to meters of kilometers (actual)	
	SCALE FACTOR						Multiple of 10		1-3 digit whole number or decimal	

[a] Refer to the Suggested Measurement Strategy for the State Objective.

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SKILL DIFFICULTY CHART

OBJECTIVE: Measurement GRADE: All

SUB.	SKILL KEYS	GRADE 1	GRADE 2	GRADE 3	GRADE 4[a]	GRADE 5[a]	GRADE 6	GRADE 7*	GRADE 8	GRADES 9-12
ALL SUBSKILLS	MEASUREMENT SYSTEMS	Metric or customary	Metric or customary	Metric or customary			Metric or customary		Metric or customary	*See Grade 9-12 Supplement.*
	TYPES OF UNITS	See Content Supplement, Units, Conversions, and Abbreviations, Grade 1.	See Content Supplement, Units, Conversions, and Abbreviations, Grades 1-2.	See Content Supplement, Units, Conversions, and Abbreviations Grades 1-3.			See Content Supplement, Units, Conversions, and Abbreviations, Grades 1-6.		See Content Supplement, Units, Conversions, and Abbreviations, Grades 1-8.	
IDENTIFYING UNITS OF MEASURE	NATURE OF PROBLEM	Identify money or time units or choose an appropriate device for measuring height, temperature, time, or weight	Choose an appropriate unit of measure	Choose an appropriate unit of measure			Choose an appropriate unit of measure		Choose an appropriate unit of measure	
ESTIMATION	NATURE OF PROBLEM	Not tested	Not tested	Estimating size, time, or weight of a displayed measurable quantity			Estimating size, time, or weight of a displayed measurable quantity		Estimating size of a planar or solid shape or a displayed measurable quantity (square or cubic units)	
USING MEASURING DEVICES	TYPES OF MEASURING DEVICES	Clocks	Clocks, rulers, thermometers, scales, money, calendar	Clocks, rulers, thermometers, scales, money, calendar, measuring cups			Not tested		Protractors	
	NATURE OF PROBLEM	Reading information from measurement devices See Content Supplement, Readings for Measurement Devices, Grade 1.	Reading information from measurement devices See Content Supplement, Readings for Measurement Devices, Grade 2.	Reading information from measurement devices See Content Supplement, Readings for Measurement Devices, Grade 3.					Reading information from measurement devices	

[a] Refer to the Suggested Measurement Strategy for the State Objective.

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SKILL DIFFICULTY CHART
GRADE 9-12 SUPPLEMENT

OBJECTIVE: Measurement GRADE: 9-12**

SUBSKILL	SKILL KEYS	GRADES 9-12**
ALL SUBSKILLS	MEASUREMENT SYSTEMS	Metric or customary
	TYPES OF UNITS	See Content Supplement, Units, Conversions, and Abbreviations, Grades 9-12
IDENTIFYING UNITS OF MEASUREMENT	NATURE OF PROBLEM	Choose an appropriate unit of measure
ESTIMATION	NATURE OF PROBLEM	By estimation or direct comparison, estimate length, area, volume, weight, or time
USING MEASURING DEVICES	TYPES OF MEASURING DEVICES	Rulers, protractors
	NATURE OF PROBLEM	Using measuring devices to determine the length of object displayed or the measure of an angle
CONVERSIONS AND OPERATIONS	NATURE OF PROBLEM	Computing (+, -, or x) with units in the same system (customary or metric) Compound measurements used with customary
	TYPES OF NUMBERS	Customary: 1- to 2-digit positive integers Metric: 1- to 2-digit positive integers
	REGROUPING REQUIRED	Yes, from one unit of measure to another

**Tested at Grade 11

ME-0.18a*

OBJECTIVE: Measurement

GRADE: 9-12**

SUBSKILL	SKILL KEYS	GRADES 9-12**
SCALE DRAWINGS	NATURE OF PROBLEM	Reading maps, floor plans, or blueprints
	SCALE CONVERSIONS	Inches (scale) to feet or miles (actual) or Centimeters (scale) to meters or kilometers (actual) Abbreviations allowed. See Content Supplement, Units, Conversions, and Abbreviations Grades 9-12.

**Tested at Grade 11

SKILL DIFFICULTY CHART
CONTENT SUPPLEMENT

READINGS FOR MEASUREMENT DEVICES

OBJECTIVE: Measurement GRADE: 1-3

Grade 1

Clocks

Face with hours numbered is used. Readings are to hour times only.

Grade 2

Clocks

Face with hours numbered is used. Readings are to hour or ½ hour.

Money

Two to three different coins (penny, nickel, dime, quarter, half-dollar) or 1 dollar bill are eligible.

Thermometers

1°F or 1°C graduations, numbered every 10°, are used. Readings are to nearest 10°. Scale is from -10°F to 110°F or from -20°C to 50°C.

Rulers

1 inch or 1 centimeter graduations are used. Units are actual size. Each graduation is numbered. Readings are to 1 inch or 1 centimeter.

Scales

(1 lb. or 1 kg graduations) Readings are to 1 lb. with numbers ≤20 lbs. Readings are to 1 kg with numbers ≤20 kg.

(10 lb. or 10 kg graduations) Readings are to 10 lb. or 10 kg with numbers ≤ 100 lbs. or ≤ 100 kg.

Calendars

One month displayed. No abbreviations. Ordinal numbers may be used.

OBJECTIVE: Measurement GRADE: 1-3

Grade 3

Clocks

Face with numbered hours is used. Readings are to nearest hour, ½ hour, or ¼ hour.

Money

Four to five different coins (penny, nickel, dime, quarter, half-dollar) or bills ($1, $5, $10, $20) are eligible.

Thermometers

1°F or 1°C graduations are used. Graduations are numbered every 10°. Readings are to nearest 5°F or 5°C. Scale is from 5°F to 100°F or from 5°C to 50°C.

Rulers

½ inch or 1 centimeter graduations are used. Units are actual size. Each graduation is numbered. Readings are to nearest ½ inch or 1 centimeter.

Scales

1 lb. or 1 kg graduations are used. Graduations are numbered every 5 units. Readings are to 1 lb. with numbers ≤100 lbs. or to 1 kg with numbers ≤100 kg.

Measuring Cups

¼ cup or 50 mL graduations are used. Readings are to nearest ¼ cup or 50 mL. Values from 0 to 1 cup or 0 to 250 mL.

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SKILL DIFFICULTY CHART
CONTENT SUPPLEMENT

UNITS, CONVERSIONS, AND ABBREVIATIONS

OBJECTIVE: Measurement GRADE: 1-3

This supplement is cumulative in the sense that units, conversions, and abbreviations at each grade should also be considered at subsequent grades.

Grade 1

Time

days of the week
months of the year
seasons of the year

Money

penny (1¢)
nickel (5¢)
dime (10¢)
quarter (25¢)

Grade 2

Time

(No additional units, conversions, or abbreviations)

Money

half-dollar (50¢)
dollar ($1.00)

Length

inches
centimeters

Weight

pounds
kilograms

Volume

cups

Temperature

°C
°F

OBJECTIVE: Measurement GRADE: 1-3

Grade 3

Time

60 seconds = 1 minute
60 minutes = 1 hour
24 hours = 1 day
7 days = 1 week
12 months = 1 year

Money

5 pennies = 1 nickel
2 nickels = 1 dime
5 nickels = 1 quarter
5 dimes = 1 half-dollar
2 quarters = 1 half-dollar
100 pennies = 1 dollar
$5, $10, and $20 bills may be shown.

Length

1 foot = 12 inches
1 yard = 36 inches
1 yard = 3 feet
1 meter = 100 centimeters

Weight

(No additional units, conversions, or abbreviations)

Volume

2 cups = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon

Temperature

(No additional units, conversions, or abbreviations)

SKILL DIFFICULTY CHART
CONTENT SUPPLEMENT

UNITS, CONVERSIONS, AND ABBREVIATIONS

OBJECTIVE: Measurement GRADE: 4-6

This supplement is cumulative in the sense that units, conversions, and abbreviations at each grade should also be considered at subsequent grades.

Grades 4 & 5

(Grades 1-3 units, conversions, and abbreviations and any other appropriate ones)

Grade 6

Time

(No additional units, conversions, or abbreviations)

Money

(No additional units, conversions, or abbreviations)

Length

1 mile = 5280 feet
1 centimeter = 10 millimeters
1 kilometer = 1000 meters
1 meter = 1000 millimeters

Weight

16 ounces = 1 pound
1 ton = 2000 pounds
1 kilogram = 1000 grams
1 metric ton = 1000 grams

Volume

1 liter = 1000 milliliters

Temperature

(No additional units, conversions, or abbreviations)

SKILL DIFFICULTY CHART
CONTENT SUPPLEMENT

UNITS, CONVERSIONS, AND ABBREVIATIONS

OBJECTIVE: Measurement GRADE: 7 & 8

This supplement is cumulative in the sense that units, conversions, and abbreviations at each grade should also be considered at subsequent grades.

Grade 7

(Grades 1-6 units, conversions, and abbreviations and any other appropriate ones)

Grade 8

Time

second(s) = sec.
minute(s) = min.
hour(s) = hr(s).
week(s) = wk(s).

Money

(No additional units, conversions, or abbreviations)

Length

meter(s) = m
centimeter(s) = cm
millimeter(s) = mm
kilometer(s) = km
foot/feet = ft.
inch(es) = in.
yard(s) = yd.
mile(s) = mi.

OBJECTIVE: Measurement GRADE: 7 & 8

Grade 8 (continued)

Weight

ounce(s) = oz.
pound(s) = lb.
kilogram(s) = kg
gram(s) = g

Volume

cup(s) = c.
pint(s) = pt.
quart(s) = qt.
gallon(s) = gal.
liter(s) = L
milliliters = mL

Temperature

(No additional units, conversions, or abbreviations)

SKILL DIFFICULTY CHART
CONTENT SUPPLEMENT

UNITS, CONVERSIONS, AND ABBREVIATIONS

OBJECTIVE: MEASUREMENT GRADE: 9-12**

This supplement contains units, conversions, and abbreviations for Grades 9-12.

Time

60 seconds = 1 minute
60 minutes = 1 hour
24 hours = 1 day
7 days = 1 week
12 months = 1 year

second(s) = sec.
minute(s) = min.
hour(s) = hr(s)
week(s) = wk(s)

Length

1 foot = 12 inches
1 yard = 36 inches
1 yard = 3 feet
1 mile = 5280 feet
1 meter = 100 centimeters
1 centimeter = 10 millimeters
1 kilometer = 1000 meters
1 meter = 1000 millimeters

foot/feet = ft.
inch(es) = in.
yard(s) = yd.
mile(s) = mi.
meter(s) = m
centimeter(s) = cm
millimeter(s) = mm
kilometer(s) = km

Weight

16 ounces = 1 pound
1 ton = 2000 pounds
1 kilogram = 1000 grams
1 metric ton = 1000 grams

ounce(s) = oz.
pound(s) = lb.
kilogram(s) = kg
gram(s) = g

Volume

2 cups = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon
1 liter = 1000 milliliters

cup(s) = c.
pint(s) = pt.
quart(s) = qt.
gallon(s) = gal.
liter(s) = L
milliliters = mL

**Tested at Grade 11

ME-8.1

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Measurement GRADE: 8

Objective

The student can apply measurement concepts.

Suggested Measurement Strategy

Answering questions about measurement. These questions may require selecting an appropriate measurement unit or measuring device; estimating or measuring length, weight, volume, or temperature in metric or customary units; converting units within a measurement system; performing calculations with measured quantities; or interpreting scale drawings.

Subskills

The solid circles ● indicate the subskills tested. The open circles O indicate the subskills for you to consider in your instruction.

● 1. Identifying Units of Measurement

The student can determine the appropriate type of measurement and select the appropriate units of measurement within a given measurement system.

● 2. Estimation

The student can estimate measurable quantities within a given measurement system.

● 3. Using Measuring Devices

The student can read and interpret information by using a measuring device within a given measurement system.

● 4. Conversions and Operations

The student can make necessary conversions using units of measurement within a given measurement system and can perform calculations which may involve conversions.

● 5. Scale Drawings

The student can read, interpret, and construct scale drawings within a given measurement system.

OBJECTIVE: Measurement GRADE: 8

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Interpretation of Pictured Measuring Devices

The student can "read" representations of the various measuring devices (for example, clocks, scales, rulers, thermometers, etc.).

○ 2. Comprehension of Measurement Situations

The student can analyze a situation described pictorially and/or verbally to determine, from the information given, what quantity or property is to be measured. This requires familiarity with the words used to describe measurable attributes (for example, "tall", "wide", "warm", "heavy", etc.).

○ 3. Knowledge of Measurement Units, Abbreviations, and Symbols

The student can recognize measurement units, symbols, and abbreviations and can associate each with a physical attribute it describes as well as a measurement device. For example, kilograms are a measure of weight determined by using a scale.

○ 4. Selection of Appropriate Measurement Units

The student can differentiate among the various units used to measure a particular attribute and recognize when each unit is most appropriate to use. For example, miles, not inches, are more appropriately used to measure long distances.

○ 5. Knowledge of Measurement Equivalents

The student knows measurement equivalents (for example, 12 inches = 1 foot, 60 seconds = 1 minute). This skill includes the ability to identify the larger/smaller unit of measure.

○ 6. Determination of Measurement Plausibility

The student is familiar with the physical properties of common objects and events so that the student can judge the reasonableness of estimations of those properties.

○ 7. Interpretation of Scaled Measurement

The student understands the concept of "scale distance" versus "actual distance" and can distinguish on a scale drawing between the units used to measure each.

ME-8.2

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Measurement GRADE: 8
SUBSKILL: Identifying Units of Measurement

Sample Item and Directions

(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)

In what units would the length of an airplane be given?

(A) millimeters

(B) cubic inches

(C) square feet

(D) meters (correct)

Write Your Own Item

ME-8.3

HOW SKILLS ARE TESTED

OBJECTIVE: Measurement GRADE: 8
SUBSKILL: Estimation

Sample Item and Directions

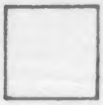
(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)



Estimate the area of this square.

(A) 1 square inch

(B) 2 square inches

(C) $\frac{1}{2}$ square inch

(D) $\frac{1}{4}$ square inch (correct)

Write Your Own Item

Use the back of this page.

HOW SKILLS ARE TESTED

OBJECTIVE: Measurement GRADE: 8
SUBSKILL: Using Measuring Devices

Sample Item and Directions

(Teacher reads.)

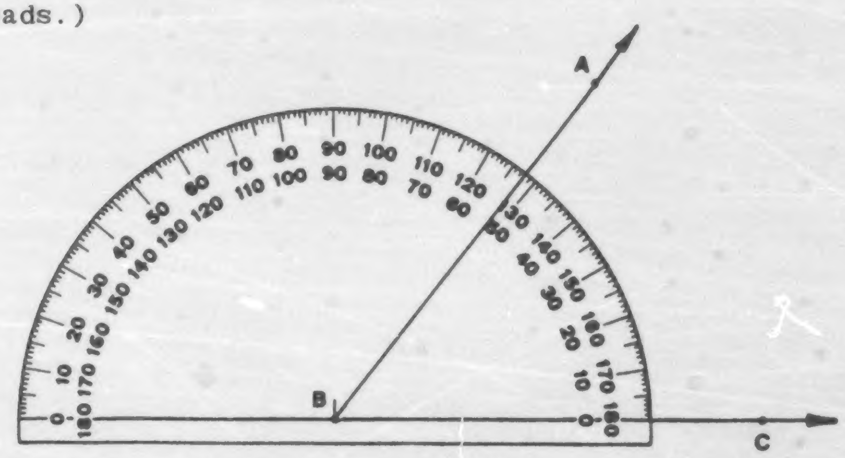
Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

- -

(Student reads.)


A
B
C
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0

What is the measure of ∠ ABC?

(A) 38°

(B) 52° (correct)

(C) 68°

(D) 128°

Write Your Own Item
Use the back of this page.

HOW SKILLS ARE TESTED

OBJECTIVE: Measurement **GRADE:** 8
SUBSKILL: Conversions and Operations

Sample Item and Directions

(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)

$$\begin{array}{r} 9\text{ ft. } 7\text{ in.} \\ +\quad 9\text{ in.} \\ \hline \end{array}$$

(A) 9 ft. 16 in.

(B) 10 ft. 0 in.

(C) 10 ft. 4 in. (correct)

(D) 10 ft. 6 in.

Write Your Own Item
Use the back of this page.

ME-8.6

HOW SKILLS ARE TESTED

OBJECTIVE: Measurement GRADE: 8
SUBSKILL: Scale Drawings

Sample Item and Directions

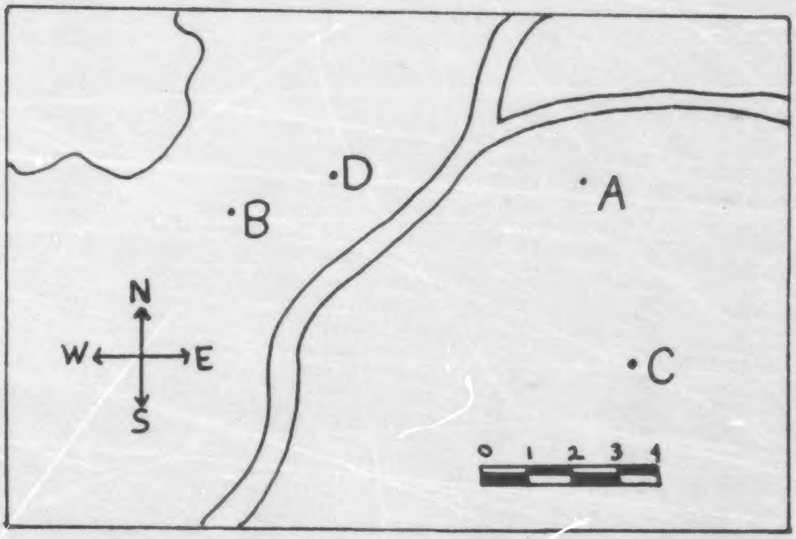
(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)



What is the approximate distance between point A and point B?

(A) 8 mi. (correct)

(B) 12 mi.

(C) 4 mi.

(D) 2 mi.

Write Your Own Item
Use the back of this page.

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Measurement GRADE: 9-12**

Objective

The student can apply measurement concepts.

Suggested Measurement Strategy

Answering questions about measurement. These questions may require selecting an appropriate measurement unit or measuring device; estimating or measuring length, weight, volume, or temperature in metric or customary units; converting units within a measurement system; performing calculations with measured quantities; or interpreting scale drawings.

Subskills

The open circles ○ indicate subskills for you to consider in your instruction. The solid circles ●, under the column labeled Grade 11, indicate the subskills tested at Grade 11.

GRADE: 9-12		GRADE: 11
○	1. Identifying Units of Measurement The student can determine the appropriate type of measurement and select the appropriate units of measurement within a given measurement system.	●
○	2. Estimation The student can estimate measurable quantities within a given measurement system.	●
○	3. Using Measuring Devices The student can read and interpret information by using a measuring device within a given measurement system.	●
○	4. Conversions and Operations The student can make necessary conversions using units of measurement within a given measurement system and can perform calculations which may involve conversions.	●
○	5. Scale Drawings The student can read, interpret, and construct scale drawings within a given measurement system.	●

**Tested at Grade 11

OBJECTIVE: Measurement GRADE: 9-12

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Interpretation of Pictured Measuring Devices

The student can "read" representations of the various measuring devices (for example, clocks, scales, rulers, thermometers, etc.).

○ 2. Comprehension of Measurement Situations

The student can analyze a situation described pictorially and/or verbally to determine, from the information given, what quantity or property is to be measured. This requires familiarity with the words used to describe measurable attributes (for example, "tall", "wide", "warm", "heavy", etc.).

○ 3. Knowledge of Measurement Units, Abbreviations, and Symbols

The student can recognize measurement units, symbols, and abbreviations and can associate each with a physical attribute it describes as well as a measurement device. For example, kilograms are a measure of weight determined by using a scale.

○ 4. Selection of Appropriate Measurement Units

The student can differentiate among the various units used to measure a particular attribute and recognize when each unit is most appropriate to use. For example, miles, not inches, are more appropriately used to measure long distances.

○ 5. Knowledge of Measurement Equivalents

The student knows measurement equivalents (for example, 12 inches = 1 foot, 60 seconds = 1 minute). This skill includes the ability to identify the larger/smaller unit of measure.

○ 6. Determination of Measurement Plausibility

The student is familiar with the physical properties of common objects and events so that the student can judge the reasonableness of estimations of those properties.

○ 7. Interpretation of Scaled Measurement

The student understands the concept of "scale distance" versus "actual distance" and can distinguish on a scale drawing between the units used to measure each.

ME-9.2

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Measurement GRADE: 9-12**
SUBSKILL: Identifying Units of Measurement

Sample Item and Directions

(Teacher/Student read.)

Directions for all problems:

1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)

> You are doing a science project on the growth of houseplants under different lighting conditions. Which units would be most appropriate to measure the growth of the plants being tested?

(A) millimeters (correct)

(B) kilometers

(C) meters

(D) yards

Write Your Own Item
Insert additional pages.

**Tested at Grade 11

HOW SKILLS ARE TESTED

OBJECTIVE: Measurement GRADE: 9-12**
SUBSKILL: Estimation

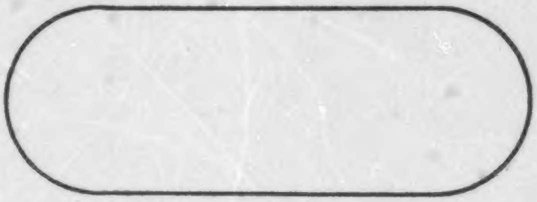
Sample Item and Directions

(Teacher/Student read.)

Directions for all problems:

1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)



Estimate the area of the figure above. Find the best answer.

(A) 1 square inch

(B) 3 square inches (correct)

(C) 6 square inches

(D) 8 square inches

Write Your Own Item

Insert additional pages.

**Tested at Grade 11

HOW SKILLS ARE TESTED

OBJECTIVE: Measurement GRADE: 9-12**
SUBSKILL: Using Measuring Devices

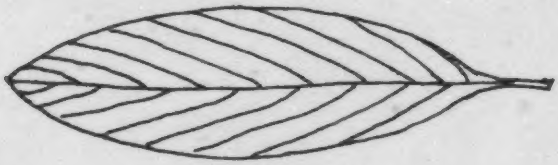
Sample Item and Directions

(Teacher/Student read.)

Directions for all problems:

1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)



Find the length.

(A) 7.5 cm

(B) 8 cm (correct)

(C) 6.5 cm

(D) 9 cm

Write Your Own Item
Insert additional pages.

**Tested at Grade 11

HOW SKILLS ARE TESTED

OBJECTIVE: Measurement GRADE: 9-12**
SUBSKILL: Conversions and Operations

Sample Item and Directions

(Teacher/Student read.)

Directions for all problems:

1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)

$$\begin{array}{r} 16 \text{ yd. } 10 \text{ in.} \\ \underline{\times \quad 6} \end{array}$$

(A) 96 yd. 6 in.

(B) 97 yd. 24 in. (correct)

(C) 99 yd.

(D) 102 yd.

Write Your Own Item

Insert additional pages.

**Tested at Grade 11

HOW SKILLS ARE TESTED

OBJECTIVE: Measurement
SUBSKILL: Scale Drawings
GRADE: 9-12**

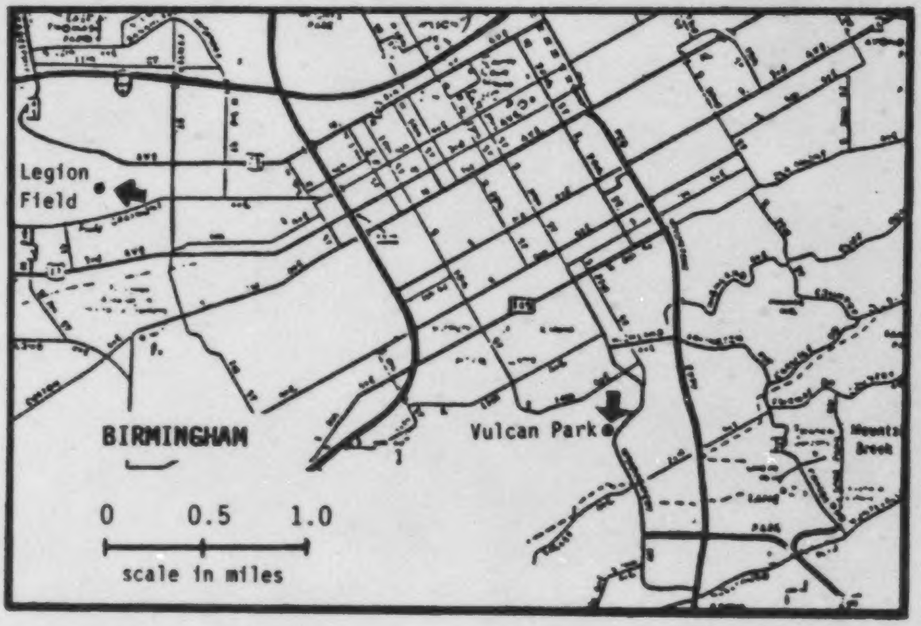
Sample Item and Directions

(Teacher/Student read.)

Directions for all problems:

1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)


Legion Field
BIRMINGHAM
Vulcan Park
Mountain Brook
0
0.5
1.0
scale in miles

What is the straight-line distance from Legion Field to Vulcan Park?

(A) 0.27 miles

(B) 0.84 miles

(C) 2.73 miles (correct)

(D) 3.25 miles

Write Your Own Item
Insert additional pages.

**Tested at Grade 11

Geometry

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TEACHING OUR SKILLS

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TEACHING OUR SKILLS

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TESTING OUR SKILLS

How Skills Are Tested GE-9.2

NOTE: * - All pages contain the same information in all booklets in the T & T Mathematics series, except for asterisked (*) pages.

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Geometry GRADE: All

Objective

The student can apply geometric concepts.

Explanation

This objective includes skills that enable students to directly relate their mathematical learning to the world around them. Students learn to identify geometric figures such as points, lines, planes, and angles through the use of their properties. In nature, examples of these figures (e.g., the spiral shell or spider web) and their properties (symmetry of bi-valve shell or butterfly) can be found. Finding perimeters, areas, and volumes of geometric figures is an important skill in itself and is also one needed in many problem-solving situations.

Subskills: Overview

The subskills identified for testing this objective are listed in the chart. The symbol O is used to indicate that the subskill is not tested but needs to be considered instructionally. The symbol ● indicates that the subskill is tested.

SUBSKILLS	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Identification** The student can identify geometric representations through the use of their properties.	●	●	●	O	O	●	O	●	O	O	O	O
2. **Comparison** The student can compare geometric representations through the use of their properties.	●	●	●	O	O	O	O	●	O	O	●	O
3. **Application** The student can apply geometric concepts to determine the perimeter area, or volume of geometric representations.				O	O	●	O	●	O	O	●	O

OBJECTIVE: Geometry GRADE: All

Other Important Skills: Overview

Instructionally, there are some other skills that must be considered in addition to those identified for testing under this objective. The symbol O is used to indicate that the skill is not tested but needs to be considered instructionally.

SKILLS	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Knowledge of Geometric Properties The student is familiar with the specific properties of each geometric figure, construction, and representation.	O	O	O	O	O	O	O	O	O	O	O	O
2. Comprehension of Geometric Vocabulary The student can read the name of each geometric figure, construction, and representation.	O	O	O	O	O	O	O	O	O	O	O	O
3. Comprehension of Comparative Vocabulary The student understands the terminology used to indicate geometric comparisons. This vocabulary includes "smallest", "largest", "same size", "same shape", "congruent", and "similar".	O	O	O	O	O	O	O	O	O	O	O	O
4. Recognition of Symmetry The student can visualize whether a figure is divided symmetrically.			O	O	O	O	O	O	O	O	O	O
5. Knowledge of Specific Formulas The student knows the formulas for perimeter, circumference, area, and volume for geometric figures.						O	O	O	O	O	O	O
6. Labeling The student can label geometric representations.						O	O	O	O	O	O	O

WHAT ARE SOME IDEAS FOR ACTIVITIES

OBJECTIVE: Geometry GRADE: All

Activities

On the following pages are some ideas for developing your own activities. These activities are intended only as examples to stimulate your thinking. The activities are not intended to be prescriptive. You can use these activities to help in building student skills.

For each activity, the purpose, the materials you need, and the directions are given. The activities are not designated by grade level since many of them can be adapted for use in earlier or later grades. You may wish to add worksheets and/or activities of your own.

Resources

Below is space for you to note resource materials appropriate for the grade(s) you teach.

Subskill	Resource Material
1. Identification	
2. Comparison	
3. Application	

GE-0.4

ACTIVITY: Sorting and Matching GRADE: Early

Purpose: To help students learn basic geometric concepts.

Materials: Set of Blocks

Obtain a set of blocks having varying characteristics: different colors, sizes, and/or shapes.

Directions:

Use the blocks for activities like those that follow.

1. Students can be asked to sort the blocks according to size, shape, number of sides, number of concerns, etc. The blocks can also be compared using the terms largest, smallest, same size, and same shape.
2. Students can prepare cutouts of geometric figures, then match those cutouts on many of the same dimensions as those described in step #1 above. The terms "congruent" and "similar" might also be introduced and used in sorting the cutouts.
3. Cards with a different shape drawn in each square can be made. One student holds up a block or a cutout and the others use a marker to cover that shape on their cards.

Example:

△	▲	○
■	□	△
▭	●	□

GE-0.5

ACTIVITY: Drawing with Geometry GRADE: Early

Purpose: To aid in students' understanding of geometric designs and pictures

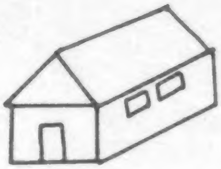
Materials: Chalkboard

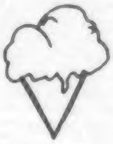
Draw one or more geometric figures on the chalkboard.

Directions:

1. Have students copy the figures on paper, then create a drawing using them. Drawings can be shared when they are completed.

   Examples:





2. As a variation, ask student to look carefully at a picture, and then list the names of all the geometric figures they can recognize in that picture.

ACTIVITY: Symmetry GRADE: Early

Purpose: To help students understand the concept of symmetry

Materials: Geometric Figure Cut-Outs

Draw some geometric figures on a sheet of paper. Draw dotted fold-lines on some figures. Omit fold-lines on others. Include figures with more than one line of symmetry, others with no lines of symmetry, and some symmetric about a point.

Directions:

1. For figures with fold-lines, ask students to predict whether the folded sides will match. Then have them verify their guess by actually folding the figures.
2. For figures with fold-lines omitted, ask the students to experiment with finding them.
3. As a variation, give students lines of symmetry to work with and have them draw figures that fit those lines. Encourage students to prepare drawings based on a wide variety of figures, not just the regular geometric figures they have been studying.

ACTIVITY: Who Am I? GRADE: Early

Purpose: To provide practice in learning geometric properties

Materials: None

Directions:

1. Begin by illustrating a "Who Am I?" riddle for students. Base the riddle on the properties of figures that have been studied in class. For example, say:

   "I have four sides.
   All of my sides are equal.
   Who am I?"

2. Once students become familiar with the riddle format, let them take turns preparing riddles for their classmates.
3. Students might be required to respond by drawing their answers, then labeling the drawing with its geometric name.

ACTIVITY: Can You Find It? GRADE: Early

Purpose: To familiarize students with the properties of geometric figures

Materials: Colored Markers or Crayons and Paper

Prepare sheets with the name of a single geometric figure at the top of each sheet (for example, closed curve, rectangle, etc.).

Directions:

1. Divide the class into teams and assign each team a different color marker or crayon with which to record its findings.

2. Give one sheet containing the name of a geometric figure to each team. Team members are to go around the room looking for as many examples of the figure listed on their sheet as they can find. They should record on their sheet the name of each object they find, using their assigned color.

3. After a specified time period, teams exchange their sheets. Now, the new team reads over what the first team did, then tries to add more examples to that list in the new team's color. Names of objects may not be repeated.

4. Continue exchanging sheets until all teams have had a chance to work on each one. At the end of the activity, the entries on each list should be verified for accuracy. After this verification, the winning team is determined by totaling up the different-colored entries to see which team recorded the most entries.

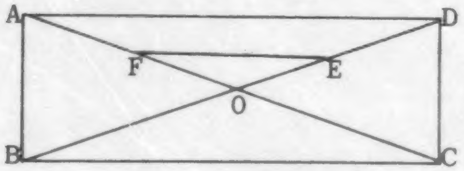
ACTIVITY: Geometric Matching GRADE: Later

Purpose: To promote learning of concepts of congruency and similarity

Materials: Worksheets with Geometric Diagrams.

Prepare a series of worksheets displaying geometric diagrams of increasing complexity. Next to each diagram provide a column headed "Congruent" and a column headed "Similar".

Example:



Congruent Similar

Make enough copies for your class.

Directions:

1. Distribute worksheets to students.

2. Ask students to identify all pairs of congruent figures and all pairs of similar figures, then list them in the appropriate columns.

Example:

Congruent	Similar
$ABC \cong DCB$	$EOF \sim BOC$
$AOB \cong DOC$	$EOF \sim DOA$
$ABD \cong DCA$	
$AOD \cong COB$	

3. When students have found all of the possible congruent and similar matches on one diagram, they should progress to the next, more difficult, diagram.

4. The class can be stopped after a pre-specified period of time and asked to identify all matches made. The student with the most number of correct matches wins.

5. Or, the class can be asked to stop after each drawing is examined, so that matches can be discussed.

GE-0.9

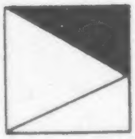
ACTIVITY: Area Investigations GRADE: Later

Purpose: To promote an intuitive understanding of the relationships between area formulas for various figures

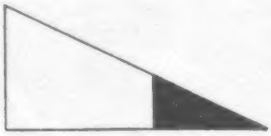
Materials: Paper, Scissors, Narrow Strips of Cardboard

Directions:

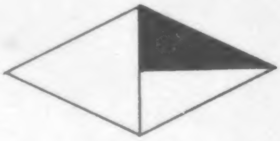
1. Have students prepare cutout geometric figures, then arrange those figures in various ways.



Square



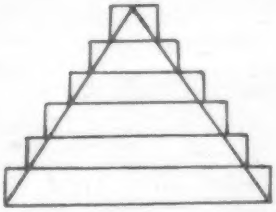
Triangle

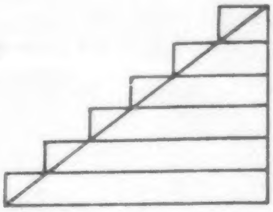


Parallelogram

2. Have students measure the dimensions of each figure arrangement, and, then use formulas to compute each figure's area. Students can verify that the areas are the same for each arrangement regardless of the figure placement.

3. To show that the area of a triangle or a parallelogram does not change if the altitude and base are fixed, have students cut narrow strips of cardboard (1 inch wide) to approximate the area of each figure. The strips are arranged into figures similar to those below:





The area of either triangle can be determined by laying the strips out end to end. Both figures have the same area since they are composed of the same strips.

ACTIVITY: Formula Follies GRADE: Later

Purpose: To promote learning of formulas for perimeter, area, and volume

Materials: A List of Formulas and Answer Keys

Make a list of formulas students are currently studying.

Directions:

1. Distribute formula lists to each student.
2. Instruct students to make up word problems that can be solved by using the formulas listed. These problems may be silly ones, if desired.

   Example: "George, the grape-colored giant, wanted to plant a vegetable garden with equal-sized plots for three crops. He decided to make each plot 10 miles long on each side. How much area does his vegetable garden cover?"

3. Have students also prepare an answer key for their problems. The answer keys should indicate the formula to be used for each problem as well as the problem's solution.
4. Problems can be exchanged and worked by other students, then checked against the answer key.

GE-0.11

ACTIVITY: Geometric Constructions GRADE: Later

Purpose: To provide practice in using measurement and geometric skills

Materials: Rulers, Compasses, and Protractors

Directions:

1. Supply students with rulers, compasses, and protractors. Then give them written or oral directions to construct specified figures. (For example, draw an equilateral triangle with sides 5 inches long.) The directions given can be simple or complex, depending upon the level of the class. Students might enjoy preparing sets of directions to present as challenges to the rest of the class. Have students label all parts of their drawings.
2. In order to practice the identification of coordinates, give students graph paper. Ask students to mark off a specified space, then direct students to locate and label a set of points [for example, R is located at the point (2, 4)].

ACTIVITY: Which One is Wrong? GRADE: Later

Purpose: To promote learning of geometric properties through geometric drawings

Materials: Set of Geometric Drawings

Prepare and label a set of geometric drawings. These drawings should cover all the figures, constructions, and representations students have studied. Each drawing should misrepresent one property of the specified figure, construction, or representation. (For example, a right triangle may lack a right angle.) Make enough copies for your class.

Directions:

1. Distribute copies to students.
2. On their copies, have students indicate the error in each drawing and correct the error.

ACTIVITY: Geoboard Configurations GRADE: Later (9-12)

Purpose: To reinforce students' knowledge of the basic properties of similar shapes

Materials: Geoboard and Rubberbands

Prepare at least one 25-peg geoboard by hammering nails partially into a board at even distances. Have rubber bands available to design geometric representations.

Directions:

1. Divide the class into two teams.
2. Ask a member of Team A to design a geometric shape on the geoboard using the rubber bands, then provide directions for a similar shape to a member of Team B.

   Example: "Make a triangle similar to this one, but three times as large."

   or

   "Make a rectangle that is one half the size of this one."
3. Have a member of Team B attempt to design the requested shape.
4. Have a student-judge measure the sides of the two figures and write the ratios of the corresponding sides on the chalkboard to see if the designs are accurate.
5. Award five points for a successful first attempt to design a similar figure; three points if the figure is correctly designed on the second attempt; and one point for a successful third attempt.
6. Have a member of Team B present a problem to Team A and continue in this manner until all students have participated in the activity.

GE-0.13*

ACTIVITY: The Shadow Knows **GRADE:** Later (9-12)

Purpose: To teach students practical uses for the ratios that can be obtained from similar figures

Materials: Measuring Devices

Obtain linear measuring devices such as rulers, yardsticks, and tape measures.

Directions:

1. Divide the class into pairs of students.

2. Have each pair select an object whose measure is unknown to the students (a flagpole, a tall tree, etc.).

3. Direct one of the students in a pair to stand beside the object to be measured. Have the other student measure his or her partner's shadow, then measure the shadow of the object itself.

4. Ask the students to prepare two ratios in the form of an equality.

   Example: $$\frac{\text{person's shadow}}{\text{person's height}} = \frac{\text{object's shadow}}{\text{object's height}}$$

   Use the proportion to calculate the height of the object in question.

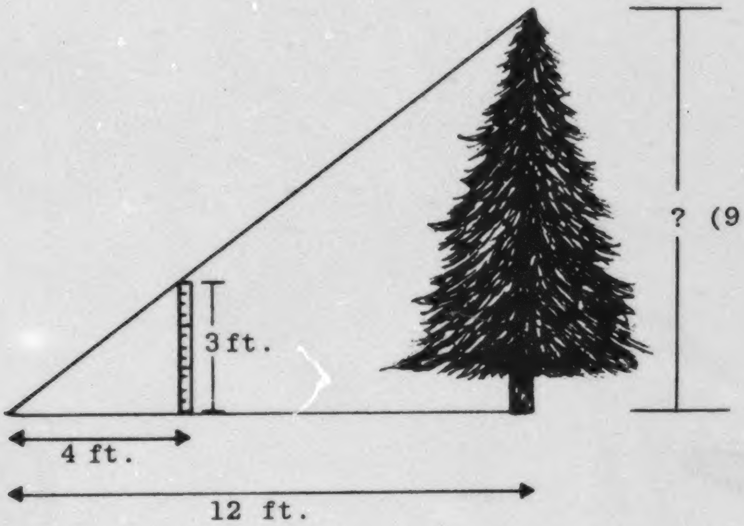
5. Check the accuracy of the object's height calculated from the proportion against the actual height of the object.

6. As an alternative, show students how to create similar triangles between an object with a known height and an object that they might wish to measure.

7. Divide the class into groups of three. Ask the students in each group to select an object to be measured and an object whose height or length they already know. For example, the students might want to find the height of a tree, using a yardstick. One student should hold the yardstick parallel, a few feet from the tree.

8. Have the second student move away from the person holding the yardstick. This second person should lean near the ground and locate the point where the top of the yardstick and the top of the tree can be sighted in a straight line.

9. The third student must then measure the distance from the sighted point to the yardstick as well as the distance from the point to the tree.



10. Ask each group of students to write ratios for their known measurements and then use those ratios in a proportion to calculate the height of the unknown object.

ACTIVITY: Geometric Scoops GRADE: Later (9-12)

Purpose: To help students make practical applications of the geometric concepts of perimeter, area, and volume

Materials: Graph Paper, Measuring Devices, and List of Problems

Obtain graph paper and measuring devices such as rulers, yardsticks, tape measures, meter sticks, cups, liters, etc. Develop a list of various problems that require measurement skills and determining perimeter, area, or volume of a figure.

Examples:

1. The school wishes to carpet the music rooms. Measure the rooms to find out how much carpet is needed.
2. Calculate the area of wall space in a classroom to determine how many cans of paint will be needed to paint the room.

Directions:

1. Assign students a list of various problems to work.
2. After the students have completed the required calculations, have them review their findings, comparing answers for accuracy.
3. Direct students who consistently make errors to recheck their measurements and calculations. Provide them with individual or group remedial assistance as needed.
4. As an additional activity, ask students to use graph paper to design accurate scale drawings of structures such as a swimming pool or a livingroom.
5. Have students determine applications of area, perimeter, or volume appropriate to the drawing. Then write these applications as questions.

   Examples:

   a. How many cubic feet of water will the pool hold?
   b. How many feet of baseboard will be necessary for the livingroom?
6. Direct students to exchange their scale drawings and related questions.
7. Have students solve the problems that they have been given and return their answers to the students who wrote the questions. Each student must check all calculations for accuracy.

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Geometry GRADE: All

Test Item Description: Overview

For Geometry, the student must select or apply a geometric concept in order to identify or compare geometric representations and figures. The student may also be required to use formulas for determining areas, perimeters, and volumes of geometric representations. Formulas may or may not be given.

As grade level increases, the test questions for each subskill become more difficult. The difficulty is controlled by the use of the SKILL KEYS presented in the following chart (for example, NATURE OF PROBLEM and TYPE OF FIGURES/TERMS).

1. Identification - The student should identify or select the correct figure, term, or label. The types of figures and terms eligible for testing increase in number as grade levels increase. In the later grades, students should be able to use labeling to identify figures.

2. Comparison - The student should be able to compare geometric representations based on size and shape and should understand the concepts of symmetry, congruence, and similarity. The types of figures eligible for testing begin with common objects/shapes and expand to include segments and angles.

3. Application - In the later grades, the student should be able to use formulas in determining the area, perimeter, or volume of geometric figures. The eligible formulas and figures increase as grade levels increase.

SUB.	SKILL KEYS	GRADE 1	GRADE 2	GRADE 3	GRADE 4[a]	GRADE 5[a]	GRADE 6	GRADE 7[a]	GRADE 8	GRADES 9-12
APPLICATION	NATURE OF PROBLEM	Not tested	Not tested	Not tested			Using formulas for area, perimeter, or volume See Content Supplement, Formulas, Grade 6.		Using formulas for area, perimeter, or volume See Content Supplement, Formulas, Grade 8.	*See Grade 9-12 Supplement.*
	TYPES OF FIGURES						Rectangle or square		Perimeter: circles or polygons Area: triangles, circles, or parallelograms Volume: rectangular prisms	
	TYPES OF NUMBERS						Whole numbers		Whole numbers	
	MEASUREMENT UNITS ALLOWED?						Inches, centimeters, feet, meters, or yards		Inches, centimeters, feet, meters, or yards	

---

[a] Refer to the Suggested Measurement Strategy for the State Objective.

1/83

GE-0.16*

SKILL DIFFICULTY CHART

OBJECTIVE: Geometry GRADE: All

SUB.	SKILL KEYS	GRADE 1	GRADE 2	GRADE 3	GRADE 4[a]	GRADE 5[a]	GRADE 6	GRADE 7[a]	GRADE 8	GRADE 9-12
IDENTIFICATION	NATURE OF PROBLEM	Identify the figure that goes with the given name.	Identify the name that goes with the figure shown.	Identify the name that goes with the figure shown.			Choose the correct figure, term, or label.		Choose the correct figure, term, or label.	*See Grade 9-12 Supplement.*
	TYPES OF FIGURES/ TERMS	See Content Supplement, Figures and Terms, Grade 1.	See Content Supplement, Figures and Terms, Grades 1-2.	See Content Supplement, Figures and Terms, Grades 1-3.			See Content Supplement, Figures and Terms, Grades 1-6.		See Content Supplement, Figures and Terms, Grades 1-8.	
COMPARISON	NATURE OF PROBLEM	Identify the largest/ smallest figure	Identify congruent or similar figures	Determining a line of symmetry or image of a figure			Not tested		Identify congruent or similar figures	
	TYPES OF FIGURES	Geometric figures or shapes of common objects	Geometric figures or shapes of common objects	Geometric figures or shapes of common objects					A geometric diagram with measured segments/ angles	

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[a] Refer to the Suggested Measurement Strategy for the State Objective.

1/83

GE-0.17*

SKILL DIFFICULTY CHART
GRADE 9-12 SUPPLEMENT

OBJECTIVE: Geometry GRADE: 9-12**

SUBSKILL	SKILL KEYS	GRADES 9-12**
IDENTIFICATION	NOT TESTED	
COMPARISON	NATURE OF PROBLEM	Identify congruent or similar figures or compare the length of corresponding parts on two similar shapes
	TYPES OF FIGURES/ TERMS	Segment lengths will be 1- to 2- digit whole numbers Extraneous line segment lengths may be included. See Content Supplement, Geometric Figures and Terms, Grades 1-8
	MEASUREMENT UNITS ALLOWED	Feet, inches, centimeters, meters, yards
APPLICATION	NATURE OF PROBLEM	Using formulas for area, perimeter, or volume See Content Supplement, Formulas, Grades 9-12.
	TYPES OF FIGURES	Polygons, circles, rectangular prisms, or parallelograms.
	TYPES OF NUMBERS	Whole numbers
	MEASUREMENT UNITS ALLOWED	Feet, inches, centimeters, meters, yards

**Tested at Grade 11

GE-0.18*

SKILL DIFFICULTY CHART
CONTENT SUPPLEMENT

GEOMETRIC FIGURES AND TERMS

OBJECTIVE: Geometry GRADE: 1-3

This supplement is cumulative in the sense that figures and terms at each grade should also be taught at subsequent grades.

Grade 1

circles
curves
  closed
  open
rectangles
squares
triangles

Grade 2

(No additional figures/terms)

Grade 3

angle
line
line segment
point (inside, on, or
  outside a figure)
ray

GE-0.19*

SKILL DIFFICULTY CHART
CONTENT SUPPLEMENT

GEOMETRIC FIGURES AND TERMS

OBJECTIVE: Geometry GRADE: 4-6

This supplement is cumulative in the sense that figures and terms at each grade should also be taught at subsequent grades.

Grade 4

(Grade 1-3 figures/terms and other appropriate ones)

Grade 5

(Grade 1-4 figures/terms and other appropriate ones)

Grade 6

- angle
  - right
- circle
  - center
  - circumference
  - diameter
  - radius
- cone
- cube
- cylinder
- lines and line segments
  - diagonal
  - equal
  - intersecting
  - parallel
  - perpendicular
- parallelogram
- points
  - intersection
  - midpoint
  - vertex
- polygon
- ray
- rhombus
- sphere
- triangles
  - equilateral
  - isoceles
  - scalene

GE-0.19a*

FORMULAS

OBJECTIVE: Geometry GRADE: 4-6

Grades 4 & 5

(Any appropriate formulas for these grades)

Grade 6

Perimeter

Rectangle: $P = 2l + 2w$

Square: $P = 4s$

Area

Rectangle: $A = l \times w$

Square: $A = s^2$

GE-0.20*

SKILL DIFFICULTY CHART
CONTENT SUPPLEMENT

GEOMETRIC FIGURES AND TERMS

OBJECTIVE: Geometry GRADE: 7 & 8

This supplement is cumulative in the sense that figures and terms at each grade should also be taught at subsequent grades.

Grade 7

(Grades 1-6 figures/terms and other appropriate ones)

Grade 8

- angles
  - acute
  - obtuse
  - straight
- bisector
  - angle bisector
  - line bisector
- coordinates of a point on a grid
- hexagon
- octagon
- pentagon
- quadrilateral
- rectangular prism
- trapezoid

FORMULAS

OBJECTIVE: Geometry GRADE: 7 & 8

Grade 7

(Grade 6 formulas and any other appropriate ones)

Grade 8

Perimeter

Rectangle: $P = 2l + 2w$

Square: $P = 4s$

Polygon: $P = \text{sum of sides}$

Area

Circle: $A = \pi r^2$

Parallelogram: $A = b \times h$ or $A = bh$

Rectangle: $A = l \times w$ or $A = lw$

Square: $A = s^2$

Triangle: $A = \frac{1}{2} \times b \times h$ or $A = \frac{1}{2}bh$

Volume

Rectangular Prism: $V = l \times w \times h$ or $V = lwh$

GE-0.21*

SKILL DIFFICULTY CHART
CONTENT SUPPLEMENT

FORMULAS

OBJECTIVE: Geometry GRADE: 9-12**

Perimeter

Rectangle: $P = 2l + 2w$

Square: $P = 4s$

Polygon: $P = \text{sum of its sides}$

Circumference

Circle: $C = 2 \times \pi \times r$ or $C = 2\pi r$ or
$C = \pi \times d$ or $C = \pi d$

Area

Circle: $A = \pi r^2$

Parallelogram: $A = b \times h$ or $A = bh$

Rectangle: $A = l \times w$ or $A = lw$

Square: $A = s^2$

Triangle: $A = \frac{1}{2} \times b \times h$ or $A = \frac{1}{2}bh$

Volume

Rectangular Prism: $V = l \times w \times h$ or $V = lwh$

Note: π will be approximated as $\frac{22}{7}$ or 3.14.

Students are provided with a formula sheet for use during the Grade 11 test; however; the figure to which the formula applies is not given.

**Tested at Grade 11

GE-8.1

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Geometry GRADE: 8

Objective

The student can apply geometric concepts.

Suggested Measurement Strategy

Answering questions about geometric representations. These questions may require identifying or comparing or contrasting geometric figures, identifying properties of geometric figures, or determining the perimeters, areas, or volumes of geometric figures.

Subskills

The solid circles ● indicate the subskills tested. The open circles O indicate the subskills for you to consider in your instruction.

● 1. Identification

The student can identify geometric representations through the use of their properties.

● 2. Comparison

The student can compare geometric representations through the use of their properties.

● 3. Application

The student can apply geometric concepts to determine the perimeter area, or volume of geometric representations.

OBJECTIVE: Geometry GRADE: 8

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Knowledge of Geometric Properties

The student is familiar with the specific properties of each geometric figure, construction, and representation.

○ 2. Comprehension of Geometric Vocabulary

The student can read the name of each geometric figure, construction, and representation eligible for testing.

○ 3. Comprehension of Comparative Vocabulary

The student understands the terminology used to indicate geometric comparisons. This vocabulary includes "smallest", "largest", "same size", same shape", "congruent", and "similar".

○ 4. Recognition of Symmetry

The student can visualize whether a figure is divided symmetrically.

○ 5. Knowledge of Specific Formulas

The student knows the formulas for perimeter, circumference, area, and volume for geometric figures.

○ 6. Labeling

The student can label geometric representations.

GE-8.2

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Geometry
SUBSKILL: Identification

GRADE: 8

Sample Item and Directions

(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

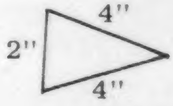
(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

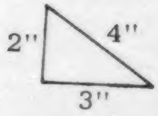
(Student reads.)

Which figure is a scalene triangle?

(A)

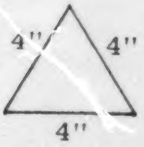


(B)

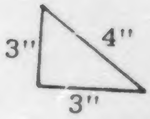


(correct)

(C)



(D)



Write Your Own Item
Use the back of this page.

HOW SKILLS ARE TESTED

OBJECTIVE: Geometry GRADE: 8
SUBSKILL: Comparison

Sample Item and Directions

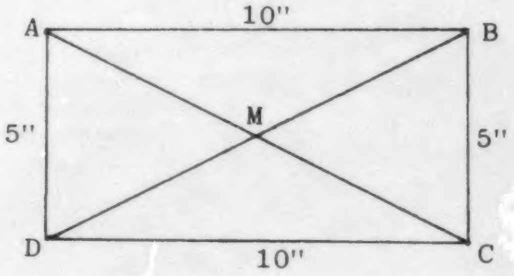
(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)



Which triangle is congruent to △ ABC?

(A) △ DMC

(B) △ BMA

(C) △ CDA (correct)

(D) △ BMC

Write Your Own Item
Use the back of this page.

HOW SKILLS ARE TESTED

OBJECTIVE: Geometry GRADE: 8
SUBSKILL: Application

Sample Item and Directions

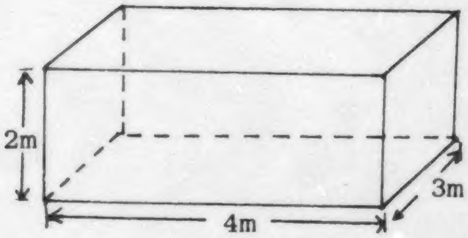
(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

(Student reads.)



The volume of the box above is?

(A) 8 cubic meters

(B) 9 cubic meters

(C) 12 cubic meters

(D) 24 cubic meters (correct)

Write Your Own Item
Use the back of this page.

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Geometry GRADE: 9-12**

Objective

The student can apply geometric concepts.

Suggested Measurement Strategy

Answering questions about geometric representations. These questions may require identifying, comparing, or constructing geometric figures; identifying properties of geometric figures, using the Pythagorean relationship; or determining the perimeters, areas, or volumes of geometric figures.

Subskills

The open circles O indicate the subskills for you to consider in your instruction. The solid circles ●, under the column labeled Grade 11, indicate the subskills tested at Grade 11.

GRADE: 9-12		GRADE: 11
○	1. **Identification** The student can identify geometric representations through the use of their properties.	○
○	2. **Comparison** The student can compare geometric representations through the use of their properties.	●
○	3. **Application** The student can apply geometric concepts to determine the perimeter area, or volume of geometric representations.	●

**Tested at Grade 11

OBJECTIVE: Geometry GRADE: 9-12

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Knowledge of Geometric Properties

The student is familiar with the specific properties of each geometric figure, construction, and representation.

○ 2. Comprehension of Geometric Vocabulary

The student can read the name of each geometric figure, construction, and representation eligible for testing.

○ 3. Comprehension of Comparative Vocabulary

The student understands the terminology used to indicate geometric comparisons. This vocabulary includes "smallest", "largest", "same size", same shape", "congruent", and "similar".

○ 4. Recognition of Symmetry

The student can visualize whether a figure is divided symmetrically.

○ 5. Knowledge of Specific Formulas

The student knows the formulas for perimeter, circumference, area, and volume for geometric figures.

○ 6. Labeling

The student can label geometric representations.

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Geometry GRADE: 9-12**
SUBSKILL: Comparison

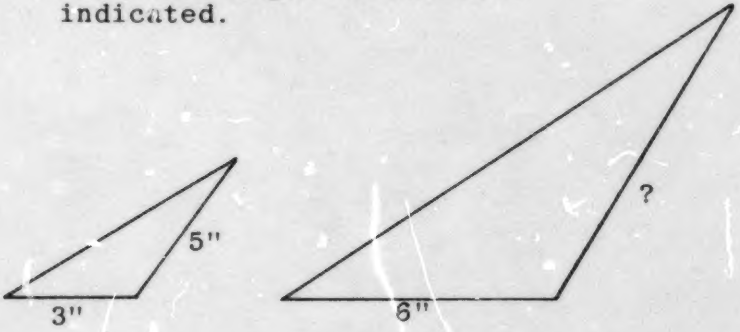
Sample Item and Directions

(Teacher/Student read.)

Directions:
1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)

The triangles below are similar. Find the length of the side indicated.



(A) 2"

(B) 10" (correct)

(C) 5"

(D) 12"

Write Your Own Item
Insert additional pages.

**Tested at Grade 11

HOW SKILLS ARE TESTED

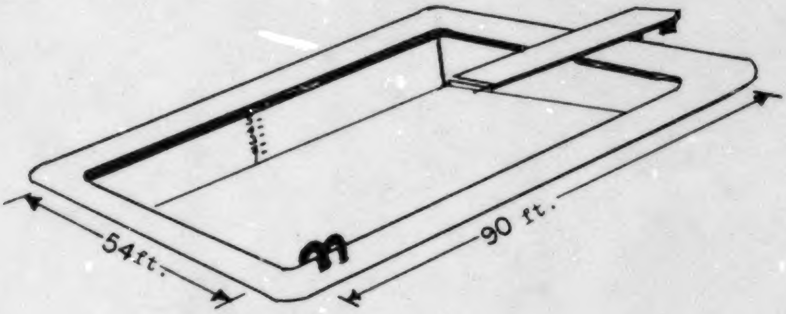
OBJECTIVE: Geometry
SUBSKILL: Application
GRADE: 9-12**

Sample Item and Directions

(Teacher/Student read.)

Directions:
1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)



The water in the pool is 5 feet deep. Find how many cubic feet of water are in the pool.

(A) 149 cubic feet

(B) 2430 cubic feet

(C) 4860 cubic feet

(D) 24300 cubic feet (correct)

Write Your Own Item
Insert additional pages.

**Tested at Grade 11

Problem Solving

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TEACHING OUR SKILLS

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TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Problem Solving GRADE: All

Objective

The student can solve problems involving the use of mathematics.

Explanation

Problem solving represents a high order intellectual skill which is central to mathematics, to other subject areas, and to applied areas. The objective requires the use of previously-acquired conceptual, operational, measurement, and geometric skills. There is no single strategy for coming up with a solution to a problem. Consider a problem such as: "If all men wear pants and I wear pants, am I a man?". A student may be able to "see" the solution immediately with no planned strategy at all. Another student may need to apply principles of logic. Thus, problem-solving is a skill that relies heavily on previous knowledge and allows students creativity in devising solution strategies.

Subskills: Overview

This objective is not broken down into subskills for testing purposes. The symbol O is used to indicate that the skill is not tested but needs to be considered instructionally. The symbol ● indicates that the skill is tested.

OBJECTIVE	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
The student can solve problems involving the use of mathematics.	●	●	●	O	O	●	O	●	O	O	●	O

Problem solving may necessitate that students do the following:

1. Analyze the problem situation. - The student must carefully read and comprehend the conditions set forth in the problem.

2. Make decisions. - Once the student has identified key elements of the problem situation, the student must make certain decisions (for example, what is to be solved for or which data to use).

3. Devise a plan. - The student may need to devise a strategy for solving the problem.

4. Judge the feasibility of the solution. After the student has determined his solution to the problem, he should judge whether: (a) his answer answers the question; (b) the answer is reasonable; and (c) the answer has the correct label. Then, the student must be able to, if necessary, defend his work.

Some problems requiring unusual solutions do not fit the pattern above. Teachers are encouraged to include from time to time such problems as brain teasers, "thought problems", etc, in their instructional programs.

OBJECTIVE: Problem Solving GRADE: All

Other Important Skills: Overview

Instructionally, there are some other skills that must be considered in addition to those identified for testing under this objective. The symbol O is used to indicate that the skill is not tested but needs to be considered instructionally.

SKILLS	GRADES											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Comprehension of Problem The student must be able to understand the vocabulary used in the problem. In BSAP, the vocabulary is kept at a low level for problem solving to minimize reading difficulty.	O	O	O	O	O	O	O	O	O	O	O	O
2. Distinguishing Between Necessary and Unnecessary Data The student must be able to select the data necessary for solving the problem, omitting unnecessary data.	O	O	O	O	O	O	O	O	O	O	O	O
3. Interpreting Graphs, Tables, Charts, and Scale Drawings The student must be able to read and interpret graphs, tables, charts, and scale drawings and be able to select data necessary for solving the problem.					O	O	O	O	O	O	O	O
4. Operations The student must be able to select the appropriate operations for solving the problem, perform them in a sequence that will result in a correct solution, and accurately carry out the necessary computations.	O	O	O	O	O	O	O	O	O	O	O	O
5. Knowledge of Measurement Units, Abbreviations, and Conversions The student must be able to use measurement units and make any necessary conversions for arriving at the problem solution.					O	O	O	O	O	O	O	O
6. Use of Formulas The student must be able to use arithmetic and geometric formulas to arrive at the problem solution.					O	O	O	O	O	O	O	O
7. Estimation The student must be able to estimate needed data from tables and charts and measures of attributes of geometric configurations. Furthermore, the student may be required to estimate to assess the feasibility of solutions.					O	O	O	O	O	O	O	O

WHAT ARE SOME IDEAS FOR ACTIVITIES

OBJECTIVE: Problem Solving GRADE: All

Activities

On the following pages are some ideas for developing your own activities. These activities are intended only as examples to stimulate your thinking. The activities are not intended to be prescriptive. You can use these activities to help in building student skills.

For each activity, the purpose, the materials you need, and the directions are given. The activities are not designated by grade level since many of them can be adapted for use in earlier or later grades. You may wish to add worksheets and/or activities of your own.

Resources

Below is space for you to note resource materials appropriate for the grade(s) you teach.

Objective	Resource Material
Problem Solving	

ACTIVITY: Story Time GRADE: Early

Purpose: To provide practice in problem solving through story-telling

Materials: A Mathematical Sentence

Write a mathematical sentence on the board or make enough copies for your class. For example: 2 + 5 = 7 or open sentence examples: 16 - ______ = 8.

Directions:

1. Distribute a mathematical sentence to the students.

2. Ask individual students or the class as a whole to make up a story to go along with that sentence. Students may enjoy creating as many different situations as they can for each sentence, being as imaginative as possible.

3. Share the story problems with another class or use them at another time as practice problems to be solved.

ACTIVITY: Drawing It Out GRADE: Early

Purpose: To promote learning in translating words into mathematical expressions

Materials: Sheets of Paper and a Selected Word Problem

Directions:

1. Begin with a sheet of blank paper divided into "story frames" or squares.

2. Read aloud the first part of the problem and let students complete the first frame of their story. For example, if the first sentence in a problem states, "Jim won ten ballons," then the first frame in the story might show a person with ten balloons.

3. Continue with the rest of the problem in sequence, first reading a part and then allowing students to draw that part.

4. When students have completed one or more teacher-guided story boards, they may enjoy some of their own. Let students devise their own problems and illustrate them. Then story boards could be exchanged and other students asked to compose the verbal problem that they think corresponds to the story board.

ACTIVITY: Acting It Out GRADE: Early

Purpose: To provide practice in problem-solving through oral presentation of problems

Materials: None

Directions:

1. Each group makes up a problem and then devises a way to dramatize that problem.
2. Each group in turn performs its problem for the others in the class.
3. The other students then solve the problem and compare their solutions with the solution previously prepared by the performing group.

ACTIVITY: Emergency! GRADE: Early

Purpose: To provide practice in solving actual problems and in approaching the various steps in the problem-solving process from several different perspectives

Materials: Incomplete "Emergency Problems"

Devise a variety of incomplete problems that need rescue efforts to make them complete. One kind of emergency situation involves problems that are missing their last sentence. Another kind of emergency involves answers that have lost their problem. Other problems can have lost their data (that is, generalized problems that need specific numbers added) and problems that have lost their explanations (that is, mathematical sentences that have lost their words). Make enough copies for each rescue team.

Directions:

1. Students can be organized into rescue teams. These teams might be medical teams or, perhaps, inter-galactic space teams sent out to rescue stranded space travelers.

2. Have each rescue team complete the problems that you have devised.

   a. For problems missing their last sentence, the rescue squad must find that sentence and then solve the entire problem to make sure their victim has been helped.

   b. For lost-answer problems, the rescue teams must organize a search party to locate their victims; that is, they must compose a problem that could result in the solution they have been given.

   c. For lost-data and lost-explanation problems, the rescue teams must search for the lost data and/or come up with explanations.

3. Let rescue teams compare their results to each problem type.

ACTIVITY: Difficulty Mountain GRADE: Later

Purpose: To help students in problem solving by monitoring difficulty levels of various problems

Materials: Large Poster Sheets

Directions:

1. Have students monitor the difficulty levels of various verbal problems assigned to the class during the course of a semester or an entire year. A problem's difficulty level equals the number of students who cannot solve the problem correctly.

2. Have the class construct a mountain of increasingly difficult problems.

3. At the end of the semester or the year, a clearly differentiated set of problems exists. Share these problems with another class as a challenging exercise for other students who want to demonstrate how high on the Difficulty Mountain they can climb.

ACTIVITY: To Tell the Truth GRADE: Later

Purpose: To help students use pictorial data to solve problems

Materials: Large Sheets of Paper

Directions:

1. Divide students into work groups.

2. Let each group survey the entire class on some topic or question.

    a. A group may decide to collect demographic information: for example, the number and ages of brother and sisters in each student's family, how far students live from school.

    b. Or a group may want to survey classmates' opinions with questions such as "What is your favorite food?".

3. Have each work group prepare some sort of visual display to depict the data they have collected. This display might be a table or chart or a graph of some type.

4. When the displays are completed have each group prepare several word problems that can be solved using its display.

5. Let other members of the class then solve these problems.

ACTIVITY: Easy to Hard GRADE: Later

Purpose: To help students realize that "hard numbers" don't necessarily mean a hard problem and to aid in attention to detail

Materials: Two Versions of a Verbal Problem

Prepare two versions of a verbal problem. For example, both versions describe the same situation and use the same words. Only the numerical data vary between version one and version two. The first version contains very simple numbers; the second version contains larger, more difficult numbers.

Directions:

1. Have students arrive at a solution strategy for solving the first version of a problem.
2. Have students check their answers.
3. Then have students apply that same strategy to the problem's second version.

ACTIVITY: Measurement GRADE: Later

Purpose: To help students apply measurement concepts to problem-solving

Materials: Different Measuring Devices

Supply students with access to as many different measuring devices as possible (for example, clocks, rulers, thermometers, measuring cups).

Directions:

1. Have each student take one or more measurements with the device he or she has, and then devise problems using those measurements.
2. After each student has had a chance to work with each measuring device, let students exchange the problems that they have written.

ACTIVITY: Tournament of Champions GRADE: Later

Purpose: To practice problem-solving skills in other than a pencil and paper exercise format

Materials: Card Sets containing Word Problems

Make a card deck consisting of one word problem on each card.

Directions:

1. Divide the class into three teams.
2. In preparation for competing in the tournament, allow each team time to practice separately with a set of cards containing word problems.
3. After the teams feel adequately prepared, begin the tournament.
   a. Three players, one from each team, compete against each other.
   b. A set of cards, with similar problems to those used during the practice sessions, is placed face down in the front of the three players.
   c. The first player turns over the top card and reads the problem aloud.
   d. Each player works out an answer.
   e. The first player offers a solution.
   f. If the solution is correct, that player keeps the card as a scoring token. If the solution is incorrect, the first opponent to challenge the answer and have the correct solution wins the scoring token.
4. After the first three players have completed their problems, let three new players come up to compete.
5. Continue play until all students have had at least one opportunity to play.

PS-0.10*

ACTIVITY: Income/Outgo GRADE: Later (9-12)

Purpose: To familiarize students with problem solving situations met in everyday life

Materials: Sample Checks, Check Registers, Deposit Slips, Utility Bills, Car Maintenance Schedules, Newspapers, or Commercial Advertisements.

Directions:

1. Assign students to investigate specific occupations in order to determine the hourly wage typically received by a person in a particular field.

2. Have students calculate a worker's weekly, monthly, and yearly wages based on the hourly rate information obtained.

3. Direct students to calculate a worker's net pay by subtracting deductions for Social Security, withholding taxes, insurance, etc., based on a flat percentage rate.

   Example: 25% of gross income = amount of withholding taxes

4. Have students design a budget for a particular worker's income. Expenses accrued on a monthly basis, such as utilities, car maintenace, etc., should be averaged to derive a figure for budgeting expenses. Expenses such as rent, clothes, food, and entertainment should also be included.

5. Ask students to write checks for these expenses, fill out deposit slips, and balance a checkbook throughout the process.

PS-0.11*

ACTIVITY: Tax Returns GRADE: Later (9-12)

Purpose: To improve students' problem solving skills in relation to completing tax return forms

Materials: Tax Forms/Schedules and Situation Cards

Obtain state and/or federal tax return forms. Obtain or duplicate appropriate federal sales tax tables and state and/or federal income tax schedules. Prepare situation cards in three categories: (1) dependent information, (2) salary information, and (3) itemizable deductions.

Examples:

> You have donated $25 to a local charity.

> You are financially responsible for your wife, your 5-year old son, and your 66-year old mother.

> Your gross income this year was $18,392. The government withheld $4,598 for federal income taxes and $1,062 for state taxes.

Directions:

1. Direct the students to draw cards from each of the three categories.
2. Have students complete the assigned federal or state tax return form using the information on the cards and appropriate tax tables.

PS-0.12*

ACTIVITY: Consumer Finances GRADE: Later (9-12)

Purpose: To provide students with opportunities to use percentages and monetary amounts in practical situations

Materials: Newspaper and Commercial Advertisements

Obtain newspaper and commercial advertisements for a variety of products.

Directions:

1. Ask students to determine the cost of furnishing a room in a house, purchasing groceries for a week, buying a winter outfit, etc., using the newspaper advertisements.
2. Give each student a percentage discount on the items chosen and ask them to calculate sales prices.
3. Have the students sub-total the amount of their purchases and calculate sales tax.
4. Direct the students to take their purchase total and amount of money tendered (i.e., a purchase total might be $42.88, the money tendered might be fifty dollars) to another student who must calculate the amount of change due on the purchase.
5. The same principle may be applied to calculating gratuities (using estimation) and the total cost of a meal; sales commission on merchandise; or interest rates for financing something and the amount of the monthly installments.

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Problem Solving GRADE: All

Test Item Description: Overview

For Problem Solving, the student is presented with a word problem. The student must be able to use computational skills and apply arithmetic, measurement, and geometric concepts to determine the solution.

As grade levels increase, the test questions become more difficult. The difficulty is controlled by the use of SKILL KEYS presented in the following chart (for example, PROBLEM TYPES and READABILITY).

A primary skill consideration is the method of obtaining the data necessary for solving the problem. In the earlier grades, students are required only to obtain data from the verbal problem. In later grades, the student may need to use data from a pictorial display (such as a chart, table, or graph) for solving the problem.

Another important consideration is the inclusion of data in a word problem that is not needed for arriving at the solution. Students should be able to determine what data is needed for the solution. Beginning with Grade 3, unneeded or unnecessary data may be present in the problem text.

A final consideration is the number of operations required in order to solve the problem which increases as grade levels increase.

In later grades, the student should be able to determine the exact, as well as the estimated, problem solution.

SKILL KEYS that are not central to the problem solving skill are minimized, for example, the reading difficulty, the types of numbers, the difficulty of performing operations, and the eligible measurement units.

SKILL DIFFICULTY CHART

OBJECTIVE: Problem Solving GRADE: All

OBJ.	SKILL KEYS	GRADE 1	GRADE 2	GRADE 3	GRADE 4 [a]	GRADE 5 [a]	GRADE 6	GRADE 7 [a]	GRADE 8	GRADES 9-12
PROBLEM SOLVING	PROBLEM TYPES	Arithmetic	Arithmetic	Arithmetic, measurement			Arithmetic, measurement, geometry		Arithmetic, measurement, geometry	*See Grade 9-12 Supplement.*
	READABILITY [b]	See chart page M-0. 5, Grade 1.	See chart page M-0. 5, Grade 2.	See chart page M-0. 5, Grade 3.			See chart page M-0. 5, Grade 6.		See chart page M-0. 5, Grade 8.	
	METHOD OF OBTAINING DATA	Verbal text	Verbal text	Verbal text			Verbal text, pictorial display		Verbal text, pictorial display	
	UNNECESSARY DATA	Not allowed	Not allowed	Not allowed			Allowed		Allowed	
	TYPES OF NUMBERS [b]	Whole numbers	Whole numbers	Whole numbers			Whole numbers, fractions, mixed numbers, decimals		Whole numbers, fractions, mixed numbers, decimals, percentages	
	NUMBER OF OPERATIONS	1	1	1-2			1-2		1-3	
	TYPES OF OPERATIONS REQUIRED [b]	Addition, subtraction	Addition, subtraction	Addition, subtraction, multiplication			Addition, subtraction, multiplication, division		Addition, subtraction, multiplication division	
	OPERATION DIFFICULTY [b]	No regrouping	No regrouping	Regrouping, direct measurement conversions only See Measurement, Content Supplement, Units, Conversions, and Abbreviations, Grade 3.			Regrouping, reduction of fractions, measurement conversions See Measurement, Content Supplement, Units, Conversions, and Abbreviations, Grade 3.		Regrouping, reduction of fractions, measurement conversions See Measurement, Content Supplement, Units, Conversions, and Abbreviations, Grade 6.	
	TYPE OF PROBLEM SOLUTION	Exact	Exact	Exact			Exact, estimated		Exact, estimated	

[a] Refer to the Suggested Measurement Strategy for the State Objective.
[b] These factors are kept at a very low level at each grade.

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SKILL DIFFICULTY CHART
GRADE 9-12 SUPPLEMENT

OBJECTIVE: Problem Solving GRADE: 9-12**

OBJECTIVE	SKILL KEYS	GRADES 9-12**
PROBLEM SOLVING	PROBLEM TYPES	Arithmetic, measurement, geometry
	READABILITY[b]	Total number of words $\leq$ 75 Each sentence $\leq$ 20 words Vocabulary $\leq$ grade 9 word list
	METHOD OF OBTAINING DATA	Verbal text, pictorial display
	UNNECESSARY DATA	Allowed
	TYPES OF NUMBERS[b]	Whole numbers, fractions, mixed numbers, decimals, percentages
	NUMBER OF OPERATIONS	1-3
	TYPES OF OPERATIONS REQUIRED[b]	Addition, subtraction, multiplication, division
	OPERATION DIFFICULTY[b]	Regrouping, reduction of fractions, measurement conversions See Problem Solving Content Supplement, Units, Conversions, Abbreviations, Grade 9-12*
	TYPE OF PROBLEM SOLUTION	Exact, estimated, or determining missing data

**Tested at Grade 11

[b] These factors are kept at a very low level at each grade.

PS-0.16*

SKILL DIFFICULTY CHART
CONTENT SUPPLEMENT

UNITS, CONVERSIONS, ABBREVIATIONS

OBJECTIVE: Problem Solving GRADE: 9-12**

__TIME__:
60 seconds = 1 minute
60 minutes = 1 hour
24 hours = 1 day
7 days = 1 week
12 months = 1 year

__LENGTH__:
1 foot = 12 inches
1 yard = 36 inches
1 yard = 3 feet
1 mile = 5280 feet
1 meter = 100 centimeters
1 centimeter = 10 millimeters
1 kilometer = 1000 meters
1 meter = 1000 millimeters

__WEIGHT__:
16 ounces = 1 pound
1 ton = 2000 pounds
1 kilogram = 1000 grams
1 metric ton = 1000 grams

__VOLUME__:
2 cups = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon
1 liter = 1000 milliliters

__Note__: These are the same units, conversions, and abbreviations eligible for testing in Grade 6, Measurement.

**Tested at Grade 11

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Problem Solving GRADE: 8

Objective

The student can solve problems requiring the use of mathematics.

Suggested Measurement Strategy

Determining the solutions to verbal and nonverbal problems. These problems may require performing one or more mathematical operations with whole numbers, fractions, mixed numbers, decimals, percents, or measurement units. The problems may also require applying a formula and/or using information presented graphically. Decision-making and alternative solution strategies may be required. Problems will focus on situations familiar to students.

OBJECTIVE: Problem Solving GRADE: 8

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Comprehension of Problem

The student must be able to understand the vocabulary used in the problem. In BSAP, the vocabulary is kept at a low level for problem solving to minimize reading difficulty.

○ 2. Distinguishing Between Necessary and Unnecessary Data

The student must be able to select the data necessary for solving the problem, omitting unnecessary data.

○ 3. Interpreting Graphs, Tables, Charts, and Scale Drawings

The student must be able to read and interpret graphs, tables, charts, and scale drawings and be able to select data necessary for solving the problem.

○ 4. Operations

The student must be able to select the appropriate operations for solving the problem, perform them in a sequence that will result in a correct solution, and accurately carry out the necessary computations.

○ 5. Knowledge of Measurement Units, Abbreviations, and Conversions

The student must be able to use measurement units and make any necessary conversions for arriving at the problem solution.

○ 6. Use of Formulas

The student must be able to use arithmetic and geometric formulas to arrive at the problem solution.

○ 7. Estimation

The student must know how to round numbers for estimating the problem solution.

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Problem Solving GRADE: 8

Sample Item and Directions

(Teacher reads.)

Read along silently as I read aloud the directions for all problems.

(Teacher/Student read.)

1. Solve the following problems.
2. Reduce all fractions to the lowest terms.
3. Mark the letter of your choice on the answer sheet.

- -

(Student reads.)

TEEN MAGAZINE

Posters of Movie Star Favorites

Special Offer!

Five Posters for $5.75
Save $1.25 off the regular price!

Send in Now! Don't be disappointed!

Add $1.50 to your total purchase to cover postage and handling.

You decide to send away for the movie posters advertised above. You want to buy ten posters. How much money should you send in?

(A) $9.90

(B) $11.50

(C) $12.00

(D) $13.00 (correct)

Write Your Own Item
Use the back of this page.

TEACHING OUR SKILLS
WHAT SKILLS OUGHT TO BE CONSIDERED

OBJECTIVE: Problem Solving GRADE: 9-12

Objective

The student can solve problems requiring the use of mathematics.

Suggested Measurement Strategy

Determining the solutions to verbal and nonverbal problems. These problems may require performing one or more mathematical operations with whole numbers, fractions, mixed numbers, decimals, percents, or measurement units. The problems may also require applying a formula and/or using information presented graphically. Problems will focus on situations which may be encountered by students now or in adult life, including those situations requiring consumer and producer skills.

OBJECTIVE: Problem Solving GRADE: 9-12

Other Important Skills

The open circles O indicate other important skills for you to consider in your instruction. Add other skills that you feel are also important.

○ 1. Comprehension of Problem

The student must be able to understand the vocabulary used in the problem. In BSAP, the vocabulary is kept at a low level for problem solving to minimize reading difficulty.

○ 2. Distinguishing Between Necessary and Unnecessary Data

The student must be able to select the data necessary for solving the problem, omitting unnecessary data.

○ 3. Interpreting Graphs, Tables, Charts, and Scale Drawings

The student must be able to read and interpret graphs, tables, charts, and scale drawings and be able to select data necessary for solving the problem.

○ 4. Operations

The student must be able to select the appropriate operations for solving the problem, perform them in a sequence that will result in a correct solution, and accurately carry out the necessary computations.

○ 5. Knowledge of Measurement Units, Abbreviations, and Conversions

The student must be able to use measurement units and make any necessary conversions for arriving at the problem solution.

○ 6. Use of Formulas

The student must be able to use arithmetic and geometric formulas to arrive at the problem solution.

○ 7. Estimation

The student must know how to round numbers for estimating the problem solution.

PS-9.2

HOW SKILLS ARE TESTED

OBJECTIVE: Problem Solving GRADE: 9-12**

Sample Item and Directions

(Teacher/Student read.)

Directions:
1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)

> It takes Howard $1\frac{1}{2}$ hours to wash and wax his father's car. Dwight takes 2 hours to do the same job. If both Howard and Dwight work on the car together, how long will the job take? Find the most reasonable answer.

(A) $\frac{1}{4}$ hour

(B) 1 hour (correct)

(C) $1\frac{1}{2}$ hours

(D) $1\frac{3}{4}$ hours

Write Your Own Item
Insert additional pages.

**Tested at Grade 11

PS-9.2.1

TESTING OUR SKILLS
HOW SKILLS ARE TESTED

OBJECTIVE: Problem Solving GRADE: 9-12**

Sample Item and Directions

(Teacher/Student read.)

Directions:
1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)

> The 11th grade is having a field trip. The class has 232 students participating. All the students are riding by bus. A bus can carry no more than 45 students. What is the smallest number of buses that they will need to carry the entire group?

(A) 4

(B) 5

(C) 6 (correct)

(D) 7

Write Your Own Item
Insert additional pages.

**Tested at Grade 11

HOW SKILLS ARE TESTED

OBJECTIVE: Problem Solving GRADE: 9-12**

Sample Item and Directions

(Teacher/Student read.)

Directions:
1. Solve the following problems.
2. Reduce all fractions to lowest terms.
3. Round off answers when needed.
4. Use the ruler, protractor, and/or formula sheet when needed.
5. Mark the letter of your choice on your answer sheet.

(Student reads.)

Read the following information:

- Ann buys ice cream bars wholesale at $3.25 for a carton of 25.
- She sells the bars for 25 cents apiece.
- On the average she works 15 hours each week.

To find out how much Ann makes an hour, you also need to be given:

(A) How many hours she works in a day

(B) How much she pays for one ice cream bar

(C) The number of bars she sells in a week (correct)

(D) The number of days she works each week

Write Your Own Item
Insert additional pages.

**Tested at Grade 11